STORE 14 DS

TECHNICAL MANUAL

RACAL RECORDERS LTD.,
Hardley Industrial Estate, Hythe,
Southampton, SO4 6ZH, England.

Telephone: SOUTHAMPTON (0703) 843265
Telex: 47600 Cables: Technico Hythe Southampton

RACAL RECORDERS INC.,
3830, Bee Ridge Road, Suite 100,
Village Plaza Professional Center,
Sarasota, Florida, 33583, U.S.A.
Telephone: (813) 921 6662. Telex: 807910. &
2736, West Orangethorpe Avenue, Suite 22/23,
Fullerton, California, 92633, U.S.A.
Telephone: (714) 738 4753.

LETHAL WARNING

Voltages within this equipment are sufficiently high to endanger life.

Covers are NOT to be removed except by persons qualified and authorised to do so and these persons should always take extreme care once the covers have been removed.

Resuscitation instructions are given overleaf.

FIRST AID in case of Electric Shock

1. Lay victim on his back.
2. Clear victim's mouth and throat.
3. Tilt victim's head back as far as possible and raise his head.
4. Pinch victim's nostrils.
5. Take a deep breath.
6. Cover the victim's mouth with yours and blow, watching his chest rise. Note: Blow forcefully into adults, but gently into children.
7. Move your face away to allow victim to breathe out, watching his chest fall.
8. Repeat first five to ten breaths at a rapid rate; thereafter, take one breath every three to five seconds.
9. Keep victim's head back as far as possible all the time.

Have someone else send for a Doctor

Keep patient warm and loosen his clothing

DO NOT Give liquids until patient is conscious

CAUTION

HANDLING PRECAUTIONS FOR MOS DEVICES

The circuits in this equipment contain MOS devices. To eliminate the possibility of damage by static electricity, the handling of electronic components or tracks on the printed circuit boards must be avoided.

Test equipment, soldering irons etc. must be earthed before being used with this equipment.

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Store 14DS

STORE 14DS

INSTRUMENTATION RECORDER

CHAPTER 1

GENERAL DESCRIPTION

1. Store 14DS equipment is a Dual Standard F.M. (Wideband 1 or Intermediate Band), and Intermediate Band D.R. Instrumentation Recorder. It may be used under fixed or mobile conditions.

2. The equipment provides 14 data channels on 12.7 mm ($\frac{1}{2}$ in) tape.

3. Two F.M. recording bandwidths are available on dual standard equipments; that is:-

at 60 in/s	Intermediate Band	DC to 20000 Hz
	Wideband 1	DC to 40000 Hz
at 30 in/s	Intermediate Band	DC to 10000 Hz
	Wideband 1	DC to 20000 Hz

and pro rata for other speeds. The D.R. mode provides a signal bandwidth between 100 Hz and 300 kHz. Signal Bandwidth is directly proportional to tape speed for both modes and is selected automatically.

4. Any combination of F.M. and D.R. channels may be employed, merely by the selection of the appropriate plug-in boards.

5. In addition to data recording a voice channel allows verbal comments, notes etc to be recorded on tape. Voice announcements interrupt data channel 14.

6. Instrumentation tape of thickness 18 µm to 35 µm may be used (corresponding to long double or triple play audio tapes). The Store 14DS uses 203 mm (8 in) precision metal spools, commonly referred to as NAB or NARTB spools. With the thinnest recommended tapes the Store 14DS allows continuous recording on all channels for over 12 hours and this time can be extended by employing bidirectional recording on fewer channels.

7. Seven tape speeds are available, from $\frac{15}{16}$ in/s to 60 in/s (2.38 cm/s to 152.4 cm/s) selectable by means of a rotary switch. The tape speed is servo controlled; the need for a heavy flywheel is eliminated, and thus accurate speed control may be maintained while recording under extreme mobile conditions, such as in vehicles etc..

8. Flutter compensation circuits are included which can be switched in to reduce noise due to recorded tape flutter on F.M. channels. This can improve the signal to noise ratio at low tape speeds.

9. The spool motors are servo controlled and ensure equal tape tension on either side of the steel capstan. Mechanical braking is applied, and tape tension removed during LOAD, when the tape runs off the spool, and when the power is OFF.

10. The tape movement controls may be selected in any order without going through the STOP function, with no danger of damaging the tape.

11. An integral meter allows monitoring of input and output signals and can be used as an aid to check the alignment of the signal electronics. The E-E mode (Electronics to Electronics) allows input signals to by-pass the record/replay heads and appear at the output when the tape is stopped. This allows alignment (of the F.M. signal electronics in particular) without the tape running.

12. The Store 14DS may be operated from a.c. supplies of 115 V ± 10% or 230 V ± 10% within a supply frequency range 48 to 400 Hz. Alternatively power may be derived from a d.c. supply within the range 11 to 32 volts. At 24 V d.c. the continuous power consumption is 100 W (60 in/s, record mode).

13. Connections to the rear panel provide for remote control of tape movement.

14. Connections to the lower front of the equipment allow remote control of individual channel record mode.

15. At the lower front of the equipment is a 15 pin plug and socket which are alternative inputs and outputs in parallel with the BNC input and output sockets.

16. A sensor is fitted which will detect reflective markers attached to the back of the tape. When a marker is sensed a STOP command is issued to the recorder and a pulse is transmitted for remote sensing. This provides a means of stopping tapes before they run off the spool, and by the addition of external control logic tape direction change, track switching etc., can be performed automatically at selected points on the tape. The sensor will differentiate between beginning-of-tape (BOT) and end-of-tape (EOT) markers.

17. A D.R. Calibration Board can be supplied if required. It can be used to define levels on tape or to give an indication of frequency response. Signals are available at band-edge frequency and $\frac{1}{10}$ band-edge frequency for all standard D.R. speeds.

CHAPTER 2

INSTALLATION AND OPERATING INSTRUCTIONS

INSTALLATION

1. It is strongly recommended that before operating the equipment, these Installation and Operating Instructions are carefully read, and that the operator becomes familiarised with the controls.

Power Supply Connections

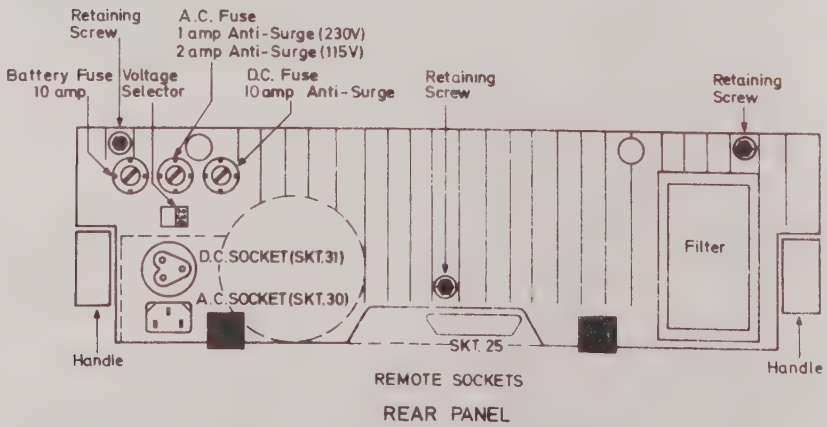
2. Operation from either a.c. or d.c. supplies is possible. Connections are made via separate cables to the a.c. and d.c. power input sockets. Both inputs are fused. When the POWER ON switch (located alongside meter) is OFF, the negative d.c. input and both line and neutral a.c. input connections are isolated from the equipment.

3. Earth Connection It is strongly recommended that the equipment is always operated with the chassis connected to ground.

4. A.C. Supply The equipment can be operated from 115V ± 10% or 230V ± 10% nominal a.c. line inputs at a supply frequency within the range 48 to 400 Hz. The voltage selector switch on the rear panel must be set to the appropriate voltage range before the recorder is connected to the supply. The a.c. input connector (SKT30) design is to the IEC320 standard and the power cable is colour coded to British Standards, i.e. Brown - line, Blue - neutral, Green/Yellow- earth.

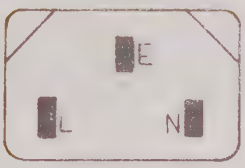
5. D.C. Supply. The equipment can be powered from a d.c. input within the range 11 to 32 volts. The d.c. input connector (SKT31) employs a 3 pin plug and socket. When a d.c. input is used, both the chassis and the signal earths are electrically isolated from the battery supply. Do not use a d.c. supply which has a current limit, since this may cause serious damage in the event of the recorder's protection circuits operating. The d.c. cable should be of heavy gauge wire (at least 24/0.2mm conductors) to avoid excessive voltage loss. The voltage at the input terminals must be at least 11 volts under all operating conditions. At low battery voltages (i.e. below about 15 volts) the recorder makes a high pitched whistling noise. This should be borne in mind when considering battery operation in an otherwise quiet environment.

6. Standby Power during a.c. operation. A battery may be connected to the d.c. input to provide power in the event of a supply failure, however to prevent high currents flowing from the rectified a.c. supply a diode must be connected in series with the battery cable. The diode should have a 12 amp (minimum) rating and be mounted on a heat sink. A 24V battery is recommended for standby use.

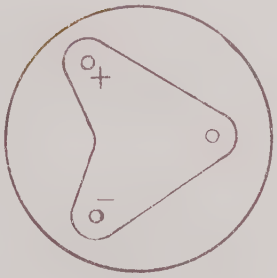


REMOTE SOCKETS

REAR PANEL

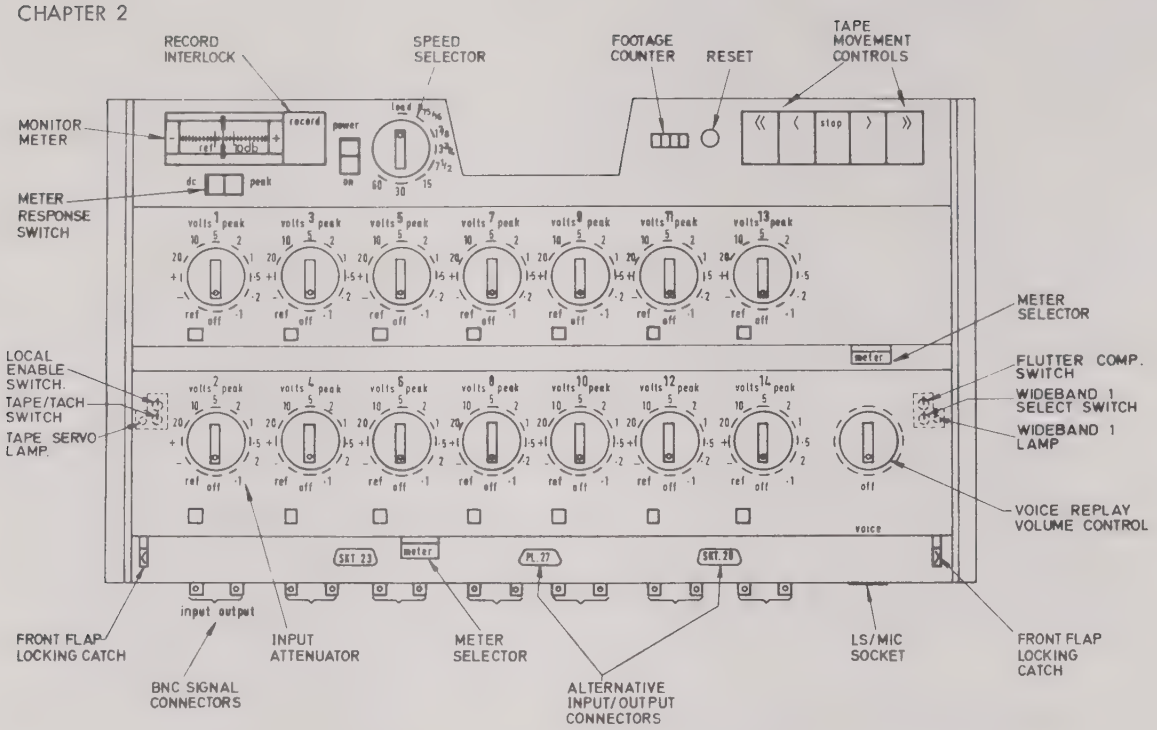


AC SOCKET (SKT 30)



DC SOCKET (SKT 31)

SUPPLY PIN CONNECTIONS.



STORE 14DS FRONT PANEL CONTROLS

Operator Controls.

7. As can be seen from the illustration, all controls are available on the front upper part of the equipment. Access to signal boards is by lifting the whole of the front flap, which is hinged, and removing the two retaining straps.

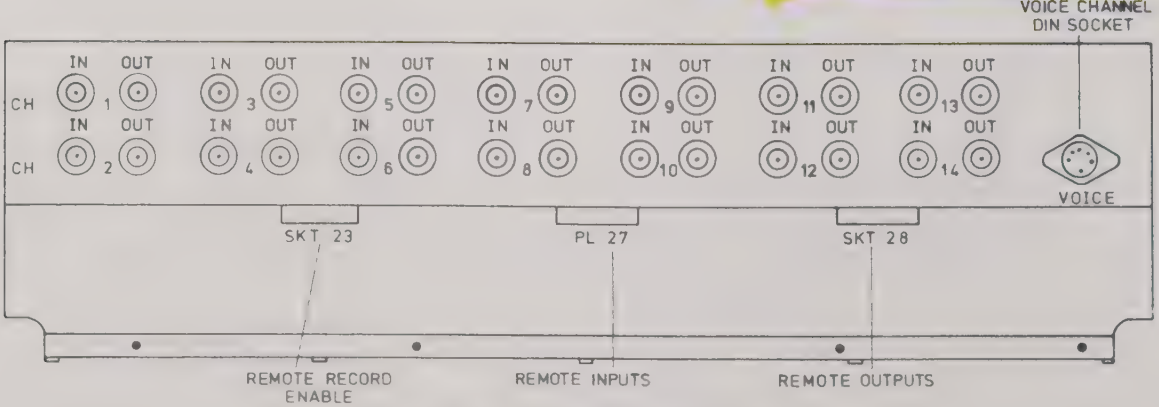
8. The TAPE/TACH, LOCAL ENABLE, FLUTTER COMPENSATION, and WIDEBAND 1 SELECT switches are also available under this cover.

Signal Connections.

9. The diagram below shows the layout of the signal inputs and outputs. The BNC connections are in parallel with the remote inputs and outputs.

10. All pin connections on SKT23, PL27, and SKT28 have the same number as the channel that they carry. Pin 15 is 0 volt in all cases.

CAUTION: Earth return currents must not be allowed to exceed 100 mA per channel. Damage to the equipment may result if this figure is exceeded.

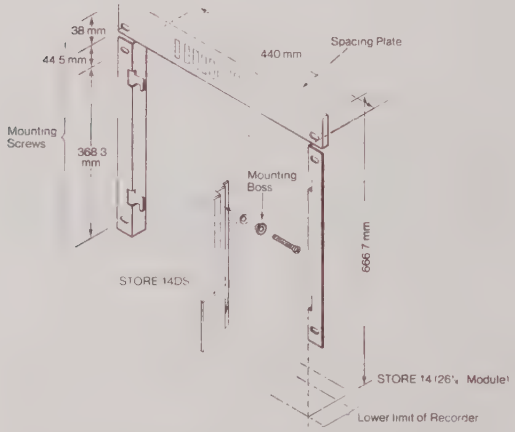


STORE 14DS SIGNAL CONNECTIONS

Rack Mounting

11. To rack mount the equipment a Rack Mounting Kit (D5831) is required. A rack height of 621 mm (26¼ in) is necessary. The side pieces supplied with the kit should be mounted to give 440 mm (17⅓ in) between the inside faces. The unit will extend 133 mm (5¼ in) above the upper key slots on the side pieces.

12. Draw the handle out of the recorder until it stops, press the catch release tabs at the rear of the handle and slide the handle clear. Remove the handle guides and catches and replace with the screw-in retainers supplied. The recorder can now be slotted into the side pieces, and the trim plate fitted above the equipment with the screws provided. Use the D-type remote connectors for signal connections. Removal is the reverse of the above procedure.



OPERATION

13. Switch On. Connect power cable to equipment (see para 2 page 3) The POWER ON switch is located on the front panel adjacent to the monitor meter. The STOP lamp will light when power is switched on.

14. Tape Loading. It should be noted that if tape thinner than 26 µm is to be used the tape tension must be readjusted; refer to Chapter 4 para 42 before loading.

15. Set the Speed Selector switch to LOAD. Normally (i.e. for forward tape travel) the full tape spool should be on the left hand hub.

If the equipment is loaded with tape, refer to para 16, otherwise load as described below.

(a) Pull the end of the tape from the full (left hand) spool, across the two tension rollers (see Diag. 1) and wrap the tape round the right hand spool. The R.H. spool should be rotated by hand until successive convolutions of tape trap and secure the tape to the spool.

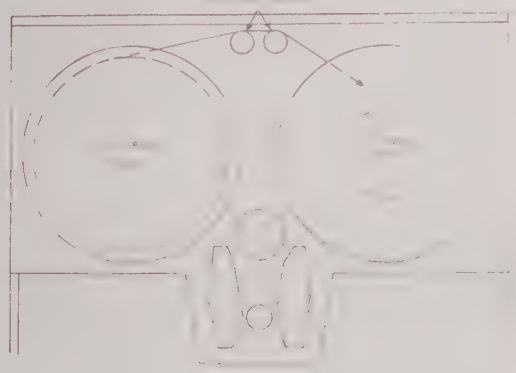


Diagram 1

(b) Pull the tape between the rollers (see Diag. 2) until the loop of tape is long enough to be dropped over the capstan. In order to avoid stretching the tape, the L.H. spool should be rotated clockwise as the loop of tape is pulled out.

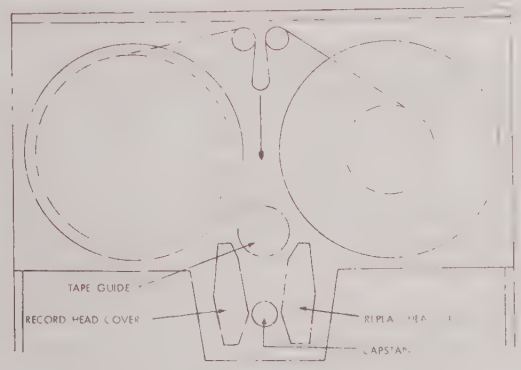


Diagram 2

(c) The tape should now be threaded as shown in Diag. 3 overleaf.

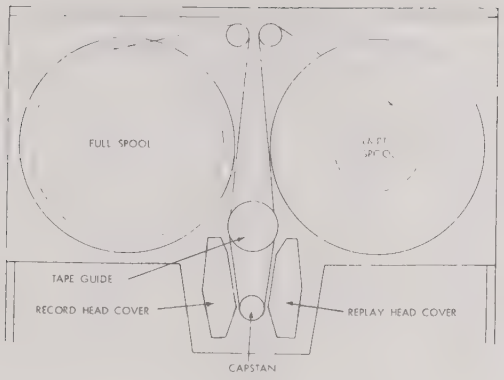


Diagram 3

16. Ensure that the tape sits squarely in the groove on the tension rollers and the central tape guide. Rotate the spools by hand so that there are no unwanted loops of tape, and the tape is taut. Failure to tension the tape as described above may result in tape damage.

17. Turn the Speed Selector to the required speed; this will energise the spool servo and tension the tape. The speed selected determines the signal bandwidth available (see paras 41 and 46).

18. The equipment is now loaded with tape and will respond to commands from the Tape Movement Pushbuttons.

19. Tape Movement Pushbuttons. There are five momentary action, illuminated, push buttons controlling tape movement as set out below:-

<<	-	fast reverse
<	-	reverse
STOP	-	stop
>	-	forward
>>	-	fast forward

Tape movement controls can be operated in any order without first going through the STOP condition. No interlocking (mechanical or electrical) is therefore required for the push buttons. The tape servo system provides safe tape handling under all conditions.

20. Tension Arms. The tension arms measure tape tension and provide feedback signals to the spool servo motors to maintain a preset tension on both side of the capstan. This tension is maintained under all operating conditions.

21. When the end of tape is reached or for any reason tape tension is lost, the tension arms sense this and lock the system into the STOP mode. In this condition all tape movement controls are inhibited. After reloading tape the system cannot be restarted unless LOAD has been selected.

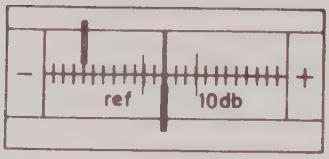
22. Before attempting to remove or adjust the tape, disable the spool servo by either switching to LOAD, or winding the tape fully onto one spool.

23. Recording. A further push button is provided to enable the RECORD mode. In order to select the RECORD mode, it is necessary to depress and hold the RECORD push button before either FORWARD or REVERSE are selected. This arrangement provides a safety feature which eliminates any danger of recording inadvertantly.

24. Input Level Controls. Input attenuators are mounted on the front panel, one for each channel. Each attenuator is located adjacent to its respective input/output B.N.C. connectors and is labelled "OFF, REF, -, +, 20, 10, 5, 2, 1, 0.5, 0.2, and 0.1". The OFF position disables the record amplifier of the respective channel. "REF, -, and +" are used to check and align the signal circuits (see para 85) and the remaining positions provide a precision attenuator scaled in volts peak.

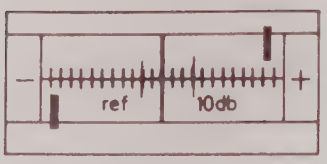
25. Setting the Record Level. To set the input record level connect the signal to the required channel input socket. Set meter response switch to "PEAK" for a.c. signals above 4 Hz. Set Meter Selector to "REC" on required channel, and choose an input attenuator setting which does not overload the meter; i.e. cause the meter to register in the orange region on either the positive or negative peaks. (See meter diagram on page 7). The d.c. offset of an input signal may be corrected by means of the OFFSET control on the Record Board. (F.M. channels only see Chapter 4 para. 53).

26. Monitor Meter. The dual movement meter is mounted on the front panel together with a PEAK - DC meter switch. The PEAK position is used for monitoring frequencies above approximately 4 Hz. In this mode, the two needles separate to display, simultaneously, positive and negative peaks. The meter will respond to peak amplitude of any pulse greater than 50 μs. The DC mode is used for frequencies below 4 Hz and for alignment (see



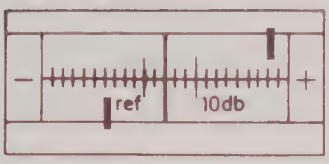
D.C. INPUT (D.C. Mode)

Top pointer indicates the d.c. input. Bottom pointer inoperative.



A.C. INPUT (PEAK Mode)

pointers show an a.c. signal about zero



A.C. INPUT WITH OFFSET

pointers have separated, showing the amplitude of the a.c. input and a positive offset

NOTE: In Wideband 1 only, when the meter slider is set to rep., and the input attenuator is set to ref., the meter will indicate full scale deflection to the left. This is not a fault condition.

para 84 page 13). In this mode, only the upper pointer is used. The movement is centre-zero i.e. negative signals deflect to the left, positive to the right.

27. Meter Selector. (Slide Switch) There are two meter selectors on the Store 14DS one for the even channels and one for the odd channels. When not in use the meter selectors should be moved to the extreme right hand end of travel. It is necessary that one of the selectors is always at the right hand end of travel as this action operates a micro switch to connect the other selector to the meter assembly.

28. Signal Monitoring. During recording the input signal may be monitored by the meter if the selector switch is set to REC. When recording in the forward direction, the meter will monitor signals off tape if the selector switch is set to REP. Similarly signals off tape will appear at the output B.N.C. socket during forward recording. When the tape is stopped the input signal is electronically switched to by-pass the tape heads and re-appear at the output socket (see E - E mode, para 63).

29. Replay. For standard replay the TAPE/TACH switch should be in the TACH position and the FLUTTER COMPENSATION switch in the OFF position (these switches are mounted beneath the front flap). To replay depress the forward or reverse button as required. If the equipment is in the RECORD mode the REPLAY mode can be obtained merely by pressing the button for the required direction.

30. Setting the Replay Level. During replay the off-tape signals may be monitored on the monitor meter by setting the Meter Selector to "REP". If the recording has been made at the correct level the meter should not register in the overload (orange) region. The output signal level is normally set to provide a 1 volt peak (2V peak to peak) signal at the output socket when the meter pointers are on the + and - lines. The output level can be adjusted to other values within the range 0V to 3V peak, (see Chapter 4 paras 50 and 66). Adjustment of this level does not affect the meter reading, hence final output level can be checked only by using an external meter. Replay levels can be checked with the tape stopped (see para 28).

31. Voice Channel. The voice channel is located at the right end of the control panel. The combined speaker/microphone unit plugs in to the DIN socket in front of the Replay Volume control.

32. The button on the microphone/louspeaker must be held depressed to record spoken notes on tape. When the button is released recorded information will be replayed through the unit. The RECORD button need not be depressed to make voice recordings; therefore if it is desired to safe-guard data on Channel 14 the microphone should be unplugged.

33. Automatic gain control eliminates the need for setting the record level. The replay level can be controlled by the Replay Volume control.

34. Voice signals are recorded on Channel 14 and Channel 14 input is interrupted whilst the button is depressed. When replaying at low tape speeds Channel 14 signals will be heard on the Voice Channel and Voice signals will appear at the Channel 14 output.

35. Tape Position Indicator (Counter Assembly). The tape position indicator, reading in feet is driven directly by the capstan via a rubber "O" ring. The reset button resets the counter to zero.

36. EOT/BOT Sensor. The Store 14DS has two sensors. The End-of-Tape (EOT) sensor will detect a reflective marker strip placed on the top half of the tape, while the Beginning-of-Tape sensor (BOT) will sense markers on the lower half of the tape. In the normal mode either of these signals will stop the tape, but by making suitable connections to the remote socket the stop signal can be inhibited and the EOT and BOT signals used for more sophisticated control functions. (See para 81). Suitable marker strips are 3M type 650.

37. Erasure. Tapes must be erased on a bulk erase unit before new recordings are made.

F.M. AND D.R. RECORDING.

38. Recording may be made using either F.M. (Frequency Modulation) or D.R. (Direct Recording) techiques, the choice depending on the signal requirements. Each signal channel has a set of three plug-in signal boards housed under the front flap, which are identified by letters on the attenuator knob. (Red - D.R., White - F.M.).

39. Any channel may be converted from F.M. to D.R. or vice versa by removing the three boards and replacing them with a set of the other type. It should be noted however that D.R. boards are normally aligned for use in a particular channel, and if they are used in a different channel the performance may be affected.

40. Any combination of D.R. and F.M. channels can be used in the recorder. Certain limitations apply when using Flutter Compensation facilities- see paras 60, 61.

41. F.M. Electronics. Signal bandwidths are as follows:-

Tape Speed	I.B. Bandwidth (Hz)	WB. 1 Bandwidth (Hz)
$\frac{15}{16}$	0 - 313	0 - 625
$1\frac{7}{8}$	0 - 625	0 - 1250
$3\frac{3}{4}$	0 - 1250	0 - 2500
$7\frac{1}{2}$	0 - 2500	0 - 5000
15	0 - 5000	0 - 10000
30	0 - 10000	0 - 20000
60	0 - 20000	0 - 40000

The required bandwidth is selected by means of a switch mounted on the Flutter Compensation Switch Assembly, under the front flap. A lamp will be illuminated whenever "Wideband 1" is selected. (The switch is labelled w.b.1). For full specification see Chapter 3.

Compatibility Between Types of F.M. Boards.

42. Original Intermediate Band F.M. signal boards, (D7709, D5823 and D6966) may be used in any recorder modified for dual standard operation. They may be mixed with dual standard boards in channels; they will operate at the intermediate Band only and may require re-alignment when so incorporated.

43. Dual Standard F.M. signal boards may be fitted in an unmodified equipment (see paragrah 44); they may also be mixed with original Intermediate Band boards in this equipment which will operate at Intermediate Band in both cases.

44. In unmodified equipments (those not carrying modification strike 9) Dual Standard boards can not be used in the following channel:-

Store 14 D Channel 14

Modification Instruction 497 (M.I. 497) is available giving details on how to rewire the recorder so that Dual Standard boards will operate in any channel. M.I.497 also contains all details necessary to convert an equipment to full Dual Standard capability.

45. A switch mounted on each filter board allows selection between two filter characteristics for each channel. The switch position marked G indicates a flat gain response (Tchebycheff filter) and position Ø selects a linear phase response (Bessel filter). Position G is used to obtain maximum flat bandwidth and minimum carrier breakthrough (i.e. best signal to noise ratio). Position Ø is used when minimum overshoot on pulse or transient signals is required. See Appendix A at the end of this handbook.

46. D.R. Electronics. Signal bandwidths are as follows:-

Tape Speed (in/s)	Bandwidth
$\frac{15}{16}$	100 Hz - 4.75 kHz
$1\frac{7}{8}$	100 Hz - 9.5 kHz
$3\frac{3}{4}$	100 Hz - 19 kHz
$7\frac{1}{2}$	100 Hz - 37 kHz
15	100 Hz - 75 kHz
30	200 Hz - 150 kHz
60	300 Hz - 300 kHz

for full specifications see Chapter 3.

TAPE PERFORMANCE

47. Tape Types. The Store 14DS is designed to operate with magnetic tape of thickness 18 μm (0.0007 in) up to 35 μm (0.0014 in). The overall performance of the equipment will largely depend on the quality of tape used.

48. Prior to dispatch from the factory this equipment will have been aligned using the tape type specified on the facia. Use of any other type of tape may result in a slightly degraded performance and in extreme cases necessitate re-alignment. (Chapter 4 para 46).

49. Tape Noise. The signal to noise ratio on D.R. channels is entirely due to tape noise. For F.M. channels at slow tape speeds the signal to noise ratio depends mainly on the flutter of the machine but this can deteriorate seriously when a noisy tape is used. With most instrumentation recorders this is also true at the higher speeds but the flutter at these speeds in the Store 14DS is so low that the tape noise becomes the predominate factor. This underlines the need to use a good quality tape for best results.

50. Drop-Out Perfomance. If a drop-out should occur on the tape, the signal to the replay electronics is momentarily lost. If this occurs the signal output will fall to zero. Whilst drop outs are inevitable with even the best quality tapes unless the strictest clean room conditions are observed, the precautions listed below, are in the experience of Racal Recorders, sufficient for normal purposes.

(a) Clean the recorder regularly, paying particular attention to the tape path.

(b) Spools should only be handled by the hub to avoid damage to the edges of the tape.

(c) Distorted spools damage the edges of the tape and therefore should not be used.

(d) Ideally the tape should never be handled. When this is not possible (e.g. when loading the tape onto the recorder) tape handling should be kept to a minimum.

(e) Tapes not in immediate use should be boxed to avoid contamination by dust and grit.

(f) Spools should be stored in boxes, and stacked on edge, preferably in a "comfortable" temperature.

(g) Magnetic fields may erase recordings, and these should therefore be avoided.

(h) Best results are obtained by bulk erasing a used tape before fresh recordings are made.

(j) Demagnetise the heads regularly.

51. Tape Tension Adjustment. The equipment as supplied will provide correct tape tension for tapes of thickness 26 μm - 35 μm. If the equipment is to be used with thinner tapes then the tape tension must be altered as indicated in Chapter 4 para 42.

ADDITIONAL OPERATIONAL MODES.

52. TAPE/TACH Speed Control. There are two modes of speed control. In the TACH mode the capstan speed is synchronized to the internal crystal oscillator. This has a stability better than 50×10^{-6} over the operating temperature range. However, if the tape stretches (or contracts) due to changes in temperature, humidity or tape tension the overall tape speed constancy between recording and subsequent replay may be worse than this. Errors of $20 \times 10^{-6}/^{\circ}C$ and 15×10^{-6} per percent relative humidity are possible.

53. Where high time base (i.e. tape speed) accuracy is important (e.g. video recordings for facsimile equipment) the TAPE mode may be used during replay. In this mode a constant frequency signal is recorded on one track during recording, and during replay it is this signal which is used to control the capstan speed, and any dimensional changes are compensated for automatically. The TAPE mode is also recommended for mobile applications where high accelerations may be encountered.

54. To use the TAPE mode proceed as follows:- Set the input attenuator of the reference channel (see para 56) to REF. Make the recording using the remaining channels for data. When replaying, set the TAPE/TACH switch (located under the front flap beneath the TAPE lamp window) to TAPE. The TAPE lamp will light, indicating that replay speed control is in the TAPE mode. When recording, internal logic selects the TACH mode irrespective of the setting of the TAPE/TACH switch.

55. In the absence of a reference signal during replay, the lamp will be extinguished and speed control automatically revert to the TACH mode. If no reference track has been recorded the switch should be set to TACH, otherwise noise from the tape may cause occasional momentary switching to the TAPE mode.

56. TAPE Reference Channel. Channel 5 is normally factory selected. If required other channels may be used as follows:- Channels 1,5, 7,9 or 13 may be selected, as reference channel by link F on the "odd" Motherboard (Fig.28).

57. The reference channel is determined by the position of link F on the Motherboard (see Fig.28 Chapter 5). To change this link the base cover of the equipment must be removed. To select channel 1,5,7,9 or 13 put link F in the appropriate position (see Fig.28).

58. Flutter Compensation. Flutter compensation affords a significant improvement in signal to noise ratio at low tape speeds. It is applicable only to F.M. recordings.

59. Flutter Compensation is achieved by recording zero input on a selected channel at the same time as data is being recorded on the other channels. Any unwanted signals caused by tape flutter will appear on this reference channel during replay and can be used to cancel out the similar signals occuring on the data channels.

60. To make a Flutter Compensated recording proceed as follows:-

(a) Ensure that the reference channels (see para 61 below) each contain a set of F.M. Signal boards. (A flutter compensated recording cannot be made with D.R. boards in the reference channels).

(b) Set the input attenuator of the reference channels to 20 V and ensure that no input is applied to these channels.

(c) Record data on the remaining channels.

(d) When replaying switch on the Flutter Compensation switch (located under the front flap). (It can be left on during recording but downstream signals will be cancelled).

(e) Return the Flutter Compensation switch to normal on completion.

61. Flutter Compensation Reference Channel. The equipment has two flutter compensation reference channels. Normally channel 8 is wired to provide flutter compensation for the even channels, and channel 7 the odd channels.

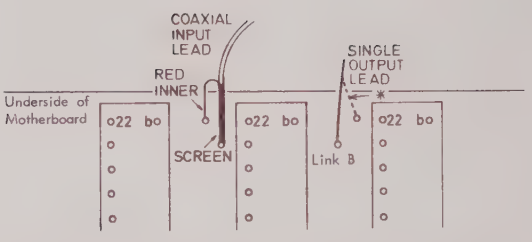
62. The reference channels for flutter compensation are selected by link D on the Motherboard (see Fig.28). A position exists for the insertion of link D in any two channels.

NOTE: It is possible to use the same reference channel for both Flutter Compensation and TAPE mode simultaneously (para 52). In this instance set the reference channel to REF (not 20 V). If older Intermediate Band boards are used in this channel they will undergo a positive d.c. level shift of 18.5% of full scale deflection.

63. E to E Mode. Normally when the equipment is in STOP, or is spooling, the channel input signals by-pass the heads and will appear at the channel outputs. This allows setting-up and certain alignment procedures to be performed without the tape running. If however the appearance of signals at the output during STOP is inconvenient, or line output signals are required whilst spooling (high speed search)., the E to E signal may be shorted out by inserting link C in each channel. The link is located on the D.R. Replay 2 Board (D.R. channels). This option is available only on D.R. channels. Bandwidth in high speed search will be modified by the replay equalization.

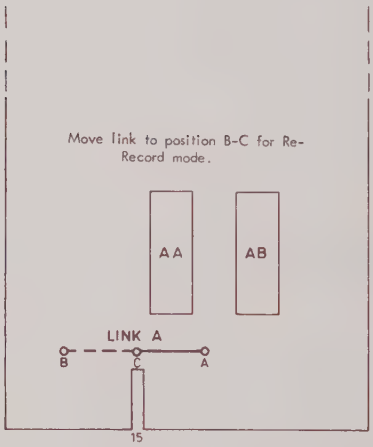
64. Re-Record Mode. (F.M. channels only). To transfer recordings from one equipment to another similar recorder, or from one track to another, the demodulator/filter circuits on the playback channel(s) can be bypassed. In this mode the recordings are not demodulated and then subsequently re-modulated as would normally be the case, thus the minimum degradation of signal quality takes place. To bypass the demodulator circuits link B on the Motherboard must be changed. This involves removing the base cover to gain access to the underside of the Motherboard, and then re-soldering the lead on the appropriate channel(s) as shown below. If ringing occurs on the output lines a termination resistor in the range 50 to 100 ohms should be inserted in series with the link B position.

65. To bypass the modulator circuits, link A on the appropriate Record Board(s) must be changed over as shown below. TTL signals may also be recorded in this mode.



RE-RECORD MODE. Disconnect output lead (colour coded:- brown - Channel 1, red - Channel 2, etc.) and solder to adjacent pin as indicated by the dotted line.

* anti-ringing resistor as in paragraph 64.



DUAL STANDARD F.M. RECORD BOARD

66. Unipolar Negative and Positive. The Unipolar Negative switch (SW1) has the effect of shifting the zero point of the record board up to maximum positive (+40%) deviation. It is then possible to apply "negative going" signals and have a working range from +40% to -40% deviation in a negative direction. Switch 1 on the F.M. Filter Board should also be selected. This will reconstitute the signal to that at the input to the equipment.

67. Unipolar Positive can be selected by switch 2 on the F.M. Record Board and F.M. Filter Board, and functions opposite to that described above (para 66).

68. Offset Controls. Offset control RV1, selected by switch 3 on F.M. Record Board, may be used to back off a d.c. component of an a.c. signal and thus move the signal to be "about zero". RV1 has a range of 20 volts.

NOTE: Switches 1 to 4 on the Record Board and 1 and 2 on the Replay Board are "made" when pushed in the direction of the arrow and "open circuit" when pushed in the reverse direction.

69. External Speed Control. Speed control is derived from an internally generated reference frequency. If it is desired to use External Speed control the following should be noted:-

(a) D.R. Recordings may be made at any speed.

(b) D.R. Recordings not replayed at one of the standard speeds will have incorrect equalisation which must be allowed for.

(c) F.M. Recording will contain d.c. offsets if a non standard speed is used for either Record or Replay.

70. External Speed Control is achieved by connecting an external signal to pin 37 of the remote control socket SKT25.

71. External Speed Control Reference should be within the following parameters:-

(a)	Input Frequency	200 kHz ± 30%
(b)	Input Amplitude	TTL (square wave) or sinusoidal, from 600Ω source coupled through 0.22μF capacitor, in the range 5V to 10V peak to peak.
(c)	Speed Variation	±30% from nominal as set on speed selector.

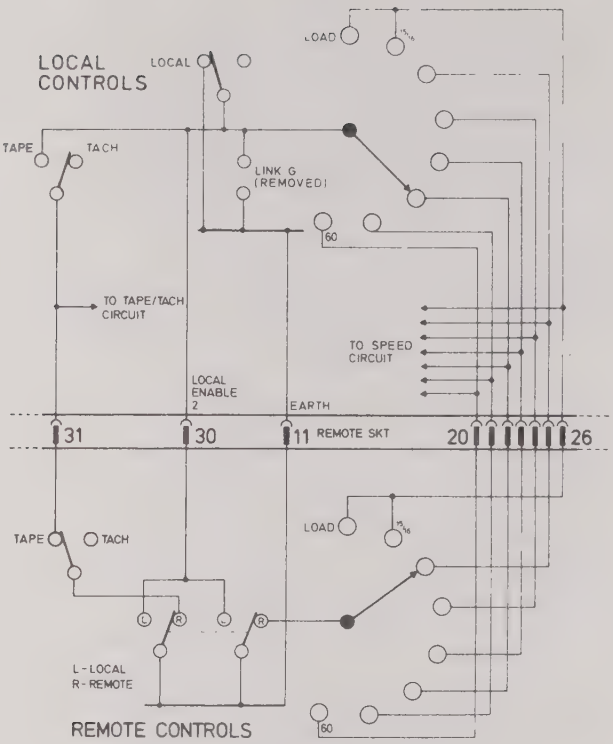
72. A signal on this line (pin 37) will override the internal crystal reference; speed of the equipment will be variable simply by changing its frequency. A specific speed can be set using the following formula:-

$$\text{Speed} = S \times \frac{f}{200}$$

where S = speed (in/s) selected by speed selector.
f = external speed reference in kHz.

REMOTE CONTROL.

73. The equipment can be operated remotely if required, via SKT25 mounted on the rear casting of the equipment and SKT23 at the front of the equipment. Tables A and B (at the end of this Chapter) list the pin number connections. For remote control, certain local controls must be disabled as indicated in the following paragraphs.



REMOTE CONTROL OF SPEED AND TAPE/TACH SELECTOR - Suggested wiring arrangement (see paras 76,79).

74. Tape Movement Pushbuttons. The equipment may be run with both local and remote tape movement controls connected. However, if it is essential that conflicting commands are not given, local control can be made non-operative by removing link H on the Deck Control Board (Fig. 30, Chapter 5).

75. It should be noted that the local control can be regained without replacing link H. This is achieved by connecting pin 12 (Local Enable 1) to pin 11 (0 V) on SKT25. If connections to these pins are run to a remote switch, then when this switch is closed, control will return to the local pushbuttons.

76. Speed Selector and Record Button. These functions are "enabled" by the "local" switch situated under the front flap. If remote operation is desired these functions should be disabled by pushing this switch away from the "local" position.

77. Local control can be regained by connecting pin 30 (local Enable 2) to pin 11 (0 V) in a way similar to that described in para 75 above.

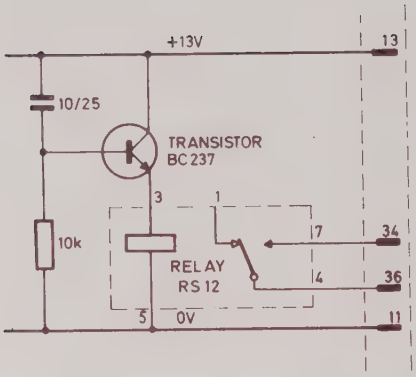
78. - TAPE/TACH switch. To allow remote operation of this function the "local" switch must be pushed away from the "local" position and TAPE/TACH switch left in the TACH position.

79. When using remote control of both speed selector and TAPE/TACH, conflicting commands may occur via the common return. The diagram above indicates how this may be avoided.

80. Remote Recording. Remote operation of the RECORD button is detailed in para 76 above. In addition, individual channels may be switched remotely. Table A lists the connections - via SKT23 at the end of this Chapter.

81. Sequential Recording. By the addition of external logic circuits the Store 14DS can use the EOT/BOT sensor signals appearing at the remote socket to initiate a recording track change and direction change at the end of the tape run. Thus for example the recorder could be arranged to record forward on channel 1 only, until at the end of tape the equipment would automatically switch to record in the reverse direction on channel 2 only. By repeated track switching and direction change, prolonged recording times may be achieved. (EOT/BOT sensors are described in para 36 page 8).

82. Remote Switch-on and LOAD. The equipment may be "switched on", and loaded by external control circuits to connect either a.c. or d.c. (battery) supplies. Provision must be made to tension the tape by activating the spool servo. A circuit to do this is shown in the diagram below;



if this circuit is used the equipment requires only the application of power to become loaded and ready to run. Carry out the following procedure:-

(a) With "power off", connect the circuit shown to the remote socket.

(b) Thread tape on the equipment and ensure that all slack is taken up by hand.

(c) Select the required speed and leave the local power switch in the "ON" position.

(d) When required, apply power to the equipment (a.c. or d.c.). The spool servo will activate by the momentary contact of pins 34 and 36 on the remote socket.

(e) To "switch off", allow the tape to come to rest, and then remove power.

83. Remote d.c. operation. It should be noted that during operation from d.c. sources Store 14DS equipments draw high currents. It is vital that the supply voltage at the equipment never falls below 11 volts. To achieve this a 24 volt supply is recommended. It may also be necessary to apply this through a relay operated system having the battery local to the equipment. The rating of the relay contacts should be at least 10 amps.

ALIGNMENT OF SIGNAL CIRCUITS.

84. Certain checks on the functioning of the signal circuits can be carried out using the "REF, +, -" positions of the input attenuator. If as a result of these or for any other reason it is felt that the signal circuits should be re-aligned then refer to Chapter 4 for the alignment procedure.

85. F.M. Check. With the monitor meter in the D.C. mode, and meter selector in REP position for the required channel, switch input attenuator to "REF, +, -". The meter should also read "REF, +, -" in turn.

86. D.R. Check. The D.R. Calibration Board (where fitted) produces a set of reference frequencies for the D.R. channels on Store 14DS equipment. It has two main uses:-

(a) In conjunction with the Monitor Meter in enables a check on the frequency response of D.R. channels without the need for external test equipment.

(b) The Calibration Board can be used to put reference levels on tape (the amplitude is specified to within 2%). This reference can be used to define the system sensitivity when tapes are subsequently replayed.

87. The table below indicates the frequencies provided by the Calibration Board. The signal level is equivalent to full rated input (i.e. equivalent for example to injecting a 1 volt peak (-0.8 dB) signal with the input attenuator set to 1 volt).

88. Frequency Response (D.R.) To check frequency response as suggested in paragraph 86 (a) proceed as follows:-

(a) Set meter switch to PEAK.

(b) Load equipment with tape. Set desired speed.

(c) With equipment to E - E (tape stopped) set meter selector to Rec.

TAPE SPEED in/s	MID-BAND REFERENCE Select "-" on channel attenuator	BAND EDGE REFERENCE Select "+" on channel attenuator
$\frac{15}{16}$	470 Hz	4.7 kHz
$1\frac{7}{8}$	950 Hz	9.5 kHz
$3\frac{3}{4}$	1.9 kHz	19 kHz
$7\frac{1}{2}$	3.75 kHz	37.5 kHz
15	7.5 kHz	75 kHz
30	15 kHz	150 kHz
60	30 kHz	300 kHz

(d) On the channel to be checked set input control attenuator to "-" (mid-band) and "+" (band-edge) in turn. Both meters should indicate full scale deflection ± 1 division (top to the right, bottom to the left) for both "-" and "+" setting.

(e) Set meter selector to Rep. Meters should still indicate full scale deflection as in (d) above.

(f) Select forward record. The meter should now indicate the equivalent of ± 3 divisions of full scale deflection as in (d) above.

(g) If this result is not achieved the following should be checked:-

(i) All heads are clean.
(ii) Correct tape type in use.
(iii) Equipment may be in need of re-alignment.

(h) Recheck other D.R. channels as required.

89. System Sensitivity can be defined on tape (as suggested in para 86 (b))

(a) During system setting up and just prior to making the recording the "-" and "+" calibration signals can be recorded on tape.

(b) On replay the amplitude of recorded data can be referenced to the calibration signals.

90. Re-Alignment. It is essential that the Calibration Board is re-aligned at intervals of not more than one year. This will maintain accuracy of calibration for which a procedure of alignment is given in Chapter 4 paras 67 and 68.

COOLING FAN

91. The cooling fan is temperature controlled. Its speed varies with temperature, and it will stop altogether when the equipment is cool.

SKT23 Pin No	Function	Action
1	Ch 1 Record	Connect pins to 0V to prevent recording on the selected channels, or enable by connecting to +13 V via 10k ohm resistor.
2	Ch 2 Record	
3	Ch 3 Record	
4	Ch 4 Record	
5	Ch 5 Record	
6	Ch 6 Record	
7	Ch 7 Record	
8	Ch 8 Record	
9	Ch 9 Record	
10	Ch 10 Record	
11	Ch 11 Record	
12	Ch 12 Record	
13	Ch 13 Record	
14	Ch 14 Record	
15	0V	

TABLE A

STORE 14DS REMOTE RECORD CONNECTIONS

TABLE B

STORE 14DS REMOTE FUNCTIONS - SKT25

SKT25 PIN NO.	FUNCTION	ENABLE	NOTES
1	Fast Reverse Command	Momentary Contact to Earth (pin 11) (4TTL Gate I/Ps)	Responds to 1ms minimum TTL '0' level sinking 6mA
2	Fast Reverse Indicator		For lamp indications connect between pin 13 (+13V) and appropriate line. Lamp 14V 0.04A.
3	Reverse Command	Momentary Contact to Earth (pin 11) (4TTL Gate I/Ps)	
4	Reverse Indicator		
5	Stop Command	Momentary Contact to Earth (pin 11) (4TTL Gate I/Ps)	
6	Stop Indicator		
7	Forward Command	Momentary Contact to Earth (pin 11) (4TTL Gate I/Ps)	
8	Forward Indicator		
9	Fast Forward Command	Momentary Contact to Earth (pin 11) (4TTL Gate I/Ps)	
10	Fast Forward Indicator		
11	Earth		
12	Local Enable 1	Earth continuously to re-enable local controls (Tape Movement Pins 1,3,5,7,9 above)	Remove link H on Store 14DS to disable local tape movement controls.
13	+13V		Total of 100mA available from pins 13 and 29
14	End of Tape		TTL '1' level while reflective strip is being sensed (duration depends on tape speed).
15	Beginning of Tape		TTL '1' level while reflective strip is being sensed (duration depends on tape speed).
16	EOT/BOT Disable	Earth continuously to prevent EOT/BOT signals automatically commanding stop.	
17	Spare		
18			
19			
20	60in/s Select	Connect any one line continuously to Earth (pin 11) for speed selection.	Local enable switch must be off when using remote speed selection. Continuous TTL '0' level on selected line. All other speed lines '1' level or open circuit
21	30 in/s Select		
22	15 in/s Select		
23	$7\frac{1}{2}$ in/s Select		
24	$3\frac{3}{4}$ in/s Select		
25	$1\frac{7}{8}$ in/s Select		
26	$\frac{15}{16}$ in/s Select		
27	Record Command	Momentary contact to Earth (pin 11) (4TTL Gate I/Ps) Forward or Reverse (pin 7 or 3) command must be given during this contact.	Responds to 3 ms minimum TTL '0' Level sinking 6mA
28	Record Indicator		Lamp (14V, 0.04A) to +13V (pin 29)
29	+13V		Total of 100mA available from pins 13 and 29
30	Local Enable 2	Earth continuously to re-enable local controls (pins 20-27) (See figure, page 12)	Assumes local enable switch pushed away from direction of arrow to disable all local controls except tape movement.
31	Tape/Tach Command	Connect continuously to earth for 'TAPE' Servo Control. Disconnect from earth for 'TACH' Servo Control.	Assumes local TAPE/TACH switch in TACH position.
32	Servo Status		Lamp (14V, 0.04A) to +13V (pin 29) Lit in Off Tape Servo mode.
33	Tachometer O/P		0 to +5V p-p square wave. 10,000 cycles/ft of tape.
34	Load	Momentary contact of pin 34 to pin 36.	See page 12
35	200kHz Crystal Reference	Output	TTL 5V square wave
36			
37	External Speed Control Reference	Input	TTL 5V square wave.

CHAPTER 3

SPECIFICATION

1. The policy of Racal Recorders Limited is one of continuous improvement, and consequently the equipment may vary in detail from the description and specification in this publication.

2. TAPE/HEAD PARAMETERS

Tape: Width: 12.7 mm ($\frac{1}{2}$ in)
Thickness: 26 to 35 μm or 18 to 26 μm if alternative tension spring (supplied) is fitted.

Spools: Type: 203 mm (8 in) diameter precision metal spools with NAB (or NARTB) hubs.

Capacity: 700 m (2300 ft) instrumentation tape. Maximum capacity 1100 m (3600 ft) of 18 μm tape.

Heads: Interlaced 7 + 7 record and reproduce head stacks in accordance with I.R.I.G. 106-73. Track width 0.025 in. Track pitch 0.070 in. Head spacing: 1.5 in ± 0.001 in.

Time Base Error (TBE) Peak time displacement between reference track and crystal reference frequency. Measured in TAPE mode according to I.R.I.G. 118-73

Tape Speed in/s	TBE (channel 5) μs zero to peak
60	± 1.5
30	± 1.5
15	± 2
$7\frac{1}{2}$	± 4
$3\frac{3}{4}$	± 8
$1\frac{7}{8}$	± 12
$\frac{15}{16}$	± 20

Interchannel Time Displacement Error (I.T.D.E.) Observed error between adjacent tracks on the same head after Record/Replay. Measured according to I.R.I.G. 118-73

Tape Speed in/s	I.T.D.E. μs zero to peak
60	±0.35
30	±0.75
15	±1.5
$7\frac{1}{2}$	± 3
$3\frac{3}{4}$	± 6
$1\frac{7}{8}$	± 12
$\frac{15}{16}$	± 25

3. TAPE TRANSPORT

Tape Speeds 60, 30, 15, $7\frac{1}{2}$, $3\frac{3}{4}$, $1\frac{7}{8}$ and $\frac{15}{16}$ in/s. (152.4, 76.2, 38.1, 19.05, 9.52, 4.76, 2.38, cm/s). Electrically selected by front panel rotary switch, or via remote socket.

Tape Speed may also be controlled by an external oscillator over the range 0.45 -90 in/s.

Tape Speed Accuracy: ±0.2% (TACH mode)

Flutter: Measured per I.R.I.G. 118-73 (2 sigma) (TACH mode).

Tape Speed in/s	Bandwidth (Hz)	%Flutter (peak to peak)
60	0.2 to 10,000	0.35
30	0.2 to 5,000	0.35
15	0.2 to 2,500	0.35
$7\frac{1}{2}$	0.2 to 1,250	0.35
$3\frac{3}{4}$	0.2 to 625	0.35
$1\frac{7}{8}$	0.2 to 313	0.45
$\frac{15}{16}$	0.2 to 156	0.55

Tape Position Indicator: 4 digit resettable counter recording in feet ±2%.

Capstan Servo Control: Internal crystal reference 100 kHz at 60 in/s, 50 kHz at 30 in/s and pro rata. Reference Oscillator stability better than $\pm 50 \times 10^{-6}$ over the operating temperature range.

Servo Control Mode: TAPE or TACH modes selectable by internal switch.

Capstan Servo Performance: Synchronisation of capstan motor to the oscillator maintained to accelerations of 100 rad/s/s.

Start Time: From Command to meeting flutter specification:-

Speed (in/s)	Time (seconds)
60	1.5
15/16	0.075

Stop Time: 1.5 s at 60 in/s

Fast Wind Time: less than 4.8 minutes for 700 m (2300 ft) of tape.

Tape Motion Controls: Momentary action push buttons for, Stop; Forward; Reverse; Fast Forward; Fast Reverse; Record. (Record electronically interlocked).

4. F.M. SIGNAL ELECTRONICS (Dual Standard). Measurements are taken as laid down in the I.R.I.G. specification 118-73.

(a) Bandwidth and Signal-to-Noise Ratio (Wideband 1).

Tape Speed in/s	Bandwidth * ±0.5 dB	Signal-to-Noise Ratio dB
60	DC to 40,000 Hz	48
30	DC to 20,000 Hz	48
15	DC to 10,000 Hz	48
7½	DC to 5,000 Hz	48
3¾	DC to 2,500 Hz	48
1⅞	DC to 1,250 Hz	46
15/16	DC to 625 Hz	44

(b) Bandwidth and Signal-to-Noise Ratio (Intermediate Band).

Tape Speed in/s	Bandwidth * ±0.5 dB	Signal-to-Noise Ratio dB
60	DC to 20,000 Hz	48
30	DC to 10,000 Hz	48
15	DC to 5,000 Hz	48
7½	DC to 2,500 Hz	48
3¾	DC to 1,250 Hz	48
1⅞	DC to 625 Hz	46
15/16	DC to 312 Hz	45

* Tchebychef Filter.

(c) Bandwidths for Bessel mode of operation are contained in the following table :-

Tape Speed in/s	Bessel Bandwidths Wideband 1 +0 dB to -3 dB	Intermediate Band +0 dB to -3 dB
60	DC to 32,000 Hz	DC to 16,000 Hz
30	DC to 16,000 Hz	DC to 8,000 Hz
15	DC to 8,000 Hz	DC to 4,000 Hz
7½	DC to 4,000 Hz	DC to 2,000 Hz
3¾	DC to 2,000 Hz	DC to 1,000 Hz
1⅞	DC to 1,000 Hz	DC to 500 Hz
15/16	DC to 500 Hz	DC to 250 Hz

Filter Response: Tchebychef (Flat response) Bessel (Linear phase response)

Flutter Compensation: Selected by means of an internal switch; can improve basic signal-to-noise ratio by up to 10 dB at low tape speeds.

Carrier Frequency: Wideband 1; 3600 Hz per inch per second of tape speed. Intermediate band; 1800 Hz per inch per second of tape speed.

Carrier Deviation: ±40%

System Drift: After 15 minutes setting period, ±0.5% of full scale output in 8 hours with 10°C change in ambient temperature.

Input Sensitivity: A twelve position switch on each Record Board is calibrated in volts peak for full carrier deviation; Range 0.1 volt to 20 volt. Additional positions are:- OFF record disable REF reference frequency. "-" full negative deviation. "+" full positive deviation.

Input Impedance: 100 k ohms ±2% in parallel with 50 pF unbalanced.

Input Overload: Input circuits are protected to a maximum continuous input of ± 100 volt.

Output:	Continuously variable from 0 to 6 volts peak to peak for full deviation.
Output Impedance:	Less than 1 ohm.
Output Current:	Output short circuit protected. Minimum load impedance 600Ω in parallel with 1,000pF.
Overall System Linearity:	±0.3% deviation from best straight line through zero.
Harmonic Distortion:	Less than 1.2% at maximum modulation level.
Intermodulation Distortion:	Less than 1%
Variable Offset:	Up to ±20 volts referred to input.
Fixed Offset:	Switch selectable for recording unipolar signals using full dynamic range.

5. D.R. SIGNAL ELECTRONICS.

Frequency Response and Signal-to-Noise Ratio:

Tape Speed (in/s)		Bandwidth (± 3dB)	Signal-to-Noise Ratio (dB)
60		300Hz to 300kHz	40
30		200Hz to 150kHz	40
15	*	100Hz to 75kHz	40
7½	*	100Hz to 37.5kHz	38
3¾	*	100Hz to 19kHz	38
1⅞	*	100Hz to 9.5kHz	38
15/16	*	100Hz to 4.75kHz	36

* Bandwidth from 50Hz is available, as an option. Signal-to-Noise will be slightly degraded.

Input Sensitivity:	A twelve position switch on each channel is calibrated in volts peak for normal record level. Range 0.1 to 20V in 8 steps. Additional positions are:-

OFF	Record Disable
REFF	Reference Frequency
"-"	Mid-band reference signal *
"+"	Band-edge reference signal *

* When calibration board is fitted.

Input Impedance:	10k ohms unbalanced shunted by less than 100pF.
Input Overload:	Input circuits are protected to a maximum continuous input of ± 100V.
Output:	Continuously variable from 0 to ±3V for normal record level.
Output Impedance:	< 10 ohms.
Output Current:	15mA peak capability, short circuit protected.
Harmonic Distortion:	1% 3rd harmonic.

6. SIGNAL MONITORING

Meter:	Simultaneous positive and negative peak indicating meter.
Meter Modes:	Peak or D.C. (selected by front panel switch).
Meter Accuracy:	±2%
Selector:	Two front panel slide controls select channel to be metered.
Response:	Meter will read the peak amplitude of any pulse greater than 50μs duration.

7. VOICE CHANNEL

Microphone/ Loudspeaker:	Dynamic, hand held, with "press to talk" switch.
Record Level:	Determined by A.G.C.
Reproduce Level:	Adjustable by front panel control.
Power output:	0.2W maximum
Channel:	Interrupts Channel 14.

8. POWER REQUIREMENTS

A.C.	115V ± 10% or 230V ± 10% 48 - 400Hz 110VA
D.C.	11 - 32V 100W at 24V

9. ENVIRONMENT

Operating Temperature:	0°C to +50°C
Storage Temperature:	-10°C to +70°C
Altitude:	4,600 m (15,000 ft) operating.
Humidity:	10 - 95% relative humidity non-condensing.
Shock:	150 m/s/s maximum (10 ms) non-operating.

10. PHYSICAL

Dimensions:	Width 482 mm (19 in) Height 156 mm (6 1/8 in) Depth 619 mm (24 3/8 in)
Weight:	With full reel of tape 27 kg (60 lb).
Rack Mounting:	May be fitted into standard 19 in racking without removing covers. Front projection: 65 mm (2 1/2 in) Rear projection: 75 mm (3 in) (See Chapter 2 para 11).
Operational Attitude:	Any plane.

NOTE: Recommended Tape (See Chapter 2 paras 47 - 49 and General Parts List, Fig.46). If tape types other than those tested and approved by Racal Recorders Ltd. are used, then the specified performance of the equipment cannot be guaranteed. The tape type supplied is now indicated on a label attached to the facia (beneath the R.H. spool)

It should be noted that the recommended tape is instrumentation quality and equivalent to "double play"

CHAPTER 4

MAINTENANCE

1. All components are generously rated to give maximum useful life with the minimum of maintenance. Nevertheless it is recommended that routine cleaning as indicated in paras 2, 3 and 4 below should be carried out. Should a fault develop which requires removal or adjustment of assemblies within the equipment, consult the appropriate paragraphs in this chapter. The Manufacturers reference number should be quoted in any correspondence relating to spares. The suggested maintenance periods may be extended if the equipment is subject to light usage in a clean environment and good quality recording tape is used.

DAILY MAINTENANCE

2. Clean the heads, tension arm rollers, and tape guide with tape cleaning fluid only, e.g. Freon TF. This is obtainable from Racal Recorders under part number, Cat 10321. Clean by rubbing gently using a cotton bud or paper tissue lightly moistened with the liquid.

NOTES : 1. Despite the instructions on the outside of cleaning fluid cans, NEVER spray the cleaning fluid directly onto the heads. Moisten the cotton bud or tissue with the liquid.

2. Use Freon TF sparingly. Do not flood the bearings with it.

3. Do not attempt to remove oxide build-up by scraping.

4. If the equipment has been out of use for a period, it is essential that the above cleaning instructions are carried out before switching on the unit.

PERIODIC MAINTENANCE

3. Most of the functions of the equipment are performed electrically, and the remaining moving parts are lubricated for life, consequently no routine maintenance is required. The lid hinges and catches may be lightly oiled when necessary. Weekly, or as required, clean the capstan shaft with a cotton bud or lint free cloth which may be lightly moistened with Freon TF if required.

Cooling Fan Filter

4. At approximately six monthly intervals the air filter should be pulled out of the rear panel and washed in warm soapy water. The filter may be removed and replaced without dismantling the equipment. In dusty conditions the filter must be cleaned more often as required.

FAULT FINDING

5. If a fault occurs, perform the appropriate checks listed below. The functioning of the equipment is described comprehensively in Chapter 5. (Consult first the block diagrams at the beginning of the chapter). Connections within the equipment are numbered and wires are colour coded accordingly (see paras 72 and 73).

6. System Failure

(a) Ensure that the equipment has been connected correctly and switched on (see Chapter 2, paras 2-5 and 13).

(b) If d.c. power is being used, check the polarity and voltage of the battery. Check the power lead to the d.c. input socket (Chapter 2, para 5).

(c) If a.c. power is being used, check the supply voltage against setting (Chapter 2, para 4). Check also the power lead to the a.c. input socket.

(d) Check that all fuses are correct and have not blown.

7. Tape Transport Malfunction

(a) Ensure that the TAPE/TACH switch is in the TACH position.

(b) Ensure that the tape has been loaded correctly. See Chapter 2, paras 14-18.

(c) Tape tension should be altered when tapes that are thinner than 26 µm are used. Check tape thickness and tension setting (see para 42 below).

(d) Instability of tension arms. If the tension arms move erratically whilst the tape is running, the tape path i.e. heads, guides and capstan should be checked and cleaned. If the fault continues, check that the brakes are not binding.

(e) Tapes that have been slit incorrectly (i.e. oversize) may jam in the guides. These should be returned to the tape supplier.

(f) If when a tape motion pushbutton is depressed the capstan turns but stops on release of the button, then the tape has not been loaded correctly (see para 7(b) above). If the tape also moves, but similarly stops on release of the button, then the tape backing may be too reflective causing the EOT or BOT sensor to be activated. A less reflective tape should be substituted.

(g) When using an equipment which may have been used for a different recording purpose check that links within the unit have not been altered - see under "additional Operational Modes" and "Remote Control" in Chapter 2.

8. Signal Malfunction

(a) Thoroughly clean the heads.

(b) Check that the oxide side of the tape faces the heads.

(c) Check signal leads and attached equipments.

(d) Ensure that the Flutter Compensation switch is in the OFF position.

(e) Ensure that the frequency and amplitude of the input signal is within the specified range - the suitability of the input signal and the functioning of the record and replay electronics can be checked using the internal meter. See Chapter 2 paras 26 - 28.

(f) When recording, ensure that the Record button is depressed before the motion pushbutton, also ensure that recordings are not being made on top of a previous recording.

(g) Check individual channels by substituting signal boards from known working channels.

(h) Check malfunction with tape stationary as well as running (signal by-passes heads when tape is stopped).

MAINTENANCE OF SUB-ASSEMBLIES

Removal and Replacement of Sub-assemblies.

9. Access to and removal of individual sub-assemblies is described in the paragraphs below. When dismantling the equipment the following points should be borne in mind:-

(a) In order to facilitate reassembly it is advisable that a note of appropriate connections should be made before dismantling any part of the machine. All connections are numbered (see circuit diagrams, Chapter 5) and the connecting wires colour coded accordingly (see para 72 and 73 below).

(b) For the majority of maintenance work involving access to the P.C. Boards etc., it is convenient to stand the machine on its rear casting, however the equipment must not be stood on end when the rear casting has been removed (see para 18 below).

(c) The Power Supply, Switching Regulator Deck Control, Capstan Servo and Spool Servo Boards all have heatsinks which are screwed onto a main assembly member, and use heat conducting compound for efficient heat transfer. When reassembling any of the above boards, it is essential to ensure that an adequate quantity of the compound is present and evenly spread over the heat transfer area. The recommended compound is Dow Corning 340, available from Hopkins and Williams, P.O. Box 53, Lane End Road, High Wycombe, Bucks.

(d) None of the above boards should be operated for long periods unless they are securely connected to the chassis. This is to aid heat dissipation.

(e) When remounting the Meter Assembly, Speed Selector Assembly, Tape Position Indicator or Pushbutton Assembly onto the deck casting, the assembly mounting screws should not be tightened until the top cover has been replaced and the assembly position adjusted for correct alignment with the top cover.

To gain access to sub-assemblies the handle and various covers may have to be removed as described in paras 10-14 below.

Removal of Base Cover.

10. Remove by extracting the four retaining screws.

Removal of Handle.

11. Pull the handle out until it stops in the normal carrying position, then press the two nylon catches now exposed behind the handle and withdraw handle completely. When replacing the handle ensure that its inner flange runs in the grooves of the nylon rollers and that the catches engage correctly.

Removal of Facia.

12. The facia is sited beneath the tape spools and covers most of the fixed sub-assemblies. To remove, first take off the handle (para 11) and tape spools. Remove the four screws adjacent to the spool hubs and tension arms using a 2.5mm socket key. The facia is a spring fit onto the side members and is removed by tapping the facia to the left with the palm of one hand and then prising the left-hand edge over the lip of the side member.

Removal of Top Cover and Front Flap.

13. To remove this complete assembly first remove handle (para 11) then remove the two screws on each side which secure the top cover to the side members.

Removal of Tinted Lid.

14. To remove, extract the top screw at either end of the Rear Casting Assembly. Care should be taken as the hinges are spring loaded. To replace, reverse the above procedure, care should be taken as the hinges will have to be held against the springs while the screws are refitted.

Signal Boards

15. The F.M. and D.R. signal boards plug into the motherboard and may be removed by raising the front flap, removing the board locating bar, and extracting the boards required. (For motherboards see Chapter 5 Fig.28). Note that the Record Boards will have to be removed before adjacent boards can be extracted. Care must be taken to ensure that D.R. cards are replaced in the channel from which they were extracted.

16. To re-align the signal boards refer to paras 46 to 66 in this chapter. To facilitate circuit checking during operation these boards may be mounted on extender cards - see Optional Accessories, Chpater 5 Fig.46.

Meter Assembly

17. To remove, first remove top cover and Channel 1 signal boards (see above). Disconnect the meter leads from the motherboard (PL57), extract the two mounting screws, and lift the complete assembly out. To replace, reverse the procedure, taking care to centralise the meter assembly in the top cover.

Power Supply Board

18. The Power Supply Board is mounted in the rear casting. To gain access to this board, disconnect the equipment from the power source, remove the three rear casting retaining screws (see diagram on page 3) and detach the rear casting.

WARNING: The rear casting is still attached to the main frame by the wire loom to SKT22 and if desired the equipment can still be operated, however care must be taken to avoid contact with high a.c. supply voltages appearing on SKT22 and the a.c. input socket, fuses etc..

Switching Regulator

19. To gain access to this unit, remove the base cover (para 10) and the regulator cover by undoing the two pozidriv screws. To remove the unit, first prise off the black caps, which cover the retaining screws (the rear casting must be removed, see para 18). Next release these screws, detach the push on wire connectors and remove the regulator. When reassembling ensure that the bushes which insulate the regulator from the main frame are in place.

Capstan Servo, Deck Control, and Spool Servo Boards.

20. To gain access to these, remove the base cover. Each board is secured by two screws through the side of the main fram into the heatsink and two screws through the p.c.board into the chassis.

Bias Oscillators and Replay Preamplifiers.

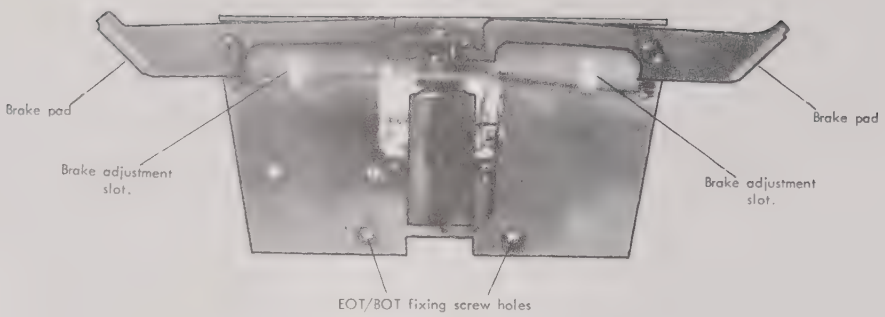
21. The facia must be removed (para 12) to reach these boards. The preamplifiers are enclosed in a screening can. The bias oscillators are mounted either side of the left hand spool assembly and are both held by screws into the chassis.

D.R.Calibration Board (Where fitted).

22. To remove the unit, proceed as follows:-

(a) Remove the base cover, handle, top cover and front flap (paras 10,11,13).

(b) Remove Voice Channel Board (para 15).



BRAKE ASSEMBLY

(c) From the underside, remove the two M3 screws which attach the Calibration Board to the Motherboard.

(d) Unplug the flat strip cable from SKT58A and SKT58B (extreme right of Motherboards when viewed from above) and remove the unit.

(e) Replacement is the reverse procedure.

Brake Assembly

23. The brake assembly consists of "fail on" spring actioned brakes, which are held "off" by a solenoid. The solenoid is powered by the Solenoid Driver Board (mounted underneath), which is in turn connected to the spool servo board. The solenoid driver board also carries through connections between the remote socket SKT25 and the EOT/BOT assembly which is mounted on top of the brake assembly.

24. Brake Assembly Adjustment. Remove facia (see para 12 above), and loosen the two brake assembly screws. Press in the solenoid as far as it will go, this brings the brakes to the released position. Take care not to exert undue bias on the spring or linkage mechanism. Adjust the entire assembly until the gaps between pad and drum are equal, and set at about 0.5mm (0.002in), whilst maintaining the solenoid fully pressed in. Tighten the assembly securing screws. Check that the solenoid operates and releases the brakes correctly by switching from LOAD to 15in/s and back, with the machine switched on.

25. The final dynamic test with tape loaded is to set the machine into the spool mode, and when it has reached full speed, move the Selector Switch to LOAD. This will cause the brakes to be applied. The tape should come to a halt without snatching, or throwing loops of tape. It should be possible to perform this test under all conditions of tape movement in both directions.

26. Brake Assembly Removal. Remove facia and base cover (see paras 10 and 12) and pull off connector wires numbers 50 to 58 at the Solenoid Driver Board. At the Deck Control Board remove Scotchflex wires 0,21,23 and 26, (from EOT/BOT). Remove the two screws securing the Brake Assembly. Lift the Brake Assembly with care, feeding the wires through the chassis.

27. Brake Pad Renewal. The brake pads are bonded onto their respective arms with Evostick 528 adhesive. To replace a brake pad, remove the assembly from the machine, firmly grip the brake arm and finally lever off the pad. Brake Pads are supplied under part number D8178 and are the only part of the Brake Assembly supplied separately.

Lamp Replacement.

28. The indicator lamps in the record and tape movement pushbuttons are replaced by pulling the appropriate button out of the equipment, and extracting the lamp from the base of the button.

NOTE: It may be found necessary to remove the top cover in order to obtain sufficient grip on the button (para 13 above).

Capstan Assembly.

29. The Capstan Assembly is a precision assembly and should not be dismantled. Should it be necessary to remove the assembly, proceed as follows:-

(a) Remove Head Plate (para 34 below).

(b) Remove counter assembly drive ring (para 30 below).

(c) Remove Tone Head Preamplifier connections and Capstan Motor connections to the Capstan Servo Board (PL55, PL56).

(d) Do not apply any voltage (a.c. or d.c.) to the Tone Wheel Head, since this will destroy the tone wheel recording, and necessitate replacement of the Capstan Assembly.

CAUTION: Continuity testing of the tone wheel head will cause the above condition and therefore must NOT be carried out.

(e) Remove all screws securing the Capstan Servo and Deck Control Boards and swing these boards aside (without removing the electrical connections).

(f) Unscrew the four capstan retaining screws (accessible from the top of the equipment) let the assembly drop slightly towards the Motherboard, and then ease out.

(g) To replace the Capstan Assembly, reverse the above instructions. When replacing the Capstan Servo and Deck Control Boards, ensure all plug-in leads are secure, particularly those to the Motherboard, and that no wires are trapped.

Tape Position Indicator (Counter Assembly)

30. Renewal of Drive Ring.

(a) Remove Head Plate (para 34 below).

(b) Ease drive ring over indicator pulley and remove from capstan.

(c) Place new drive ring over capstan and ease onto indicator pulley.

(d) Ensure drive ring runs in the groove in the capstan.

(e) Replace Head Plate.

31. Removal of Tape Position Indicator

(a) Remove top cover and facia.

(b) Ease drive ring off indicator pulley.

(c) Extract the two screws securing the indicator bracket to the deck casting and remove the assembly.

(d) When re-assembling ensures that the drive ring runs in the groove in the capstan.

(e) Before tightening the two screws securing the Tape Position Indicator bracket to the deck casting offer the top cover to the Indicator Assembly, (see para 9 (e)).

EOT/BOT Assembly

32. The assembly is attached to the brake assembly (see figure on page 24). Removal is achieved by disconnecting the leads from the Deck Control Board and the terminals on the Solenoid Driver Board, and removing the two retaining screws. Adjustment can be carried out by loosening the same two retaining screws. Correct adjustment is obtained when the EOT and BOT sensors are equidistant from the tape.

33. The operation of the sensors can be checked as follows:-

(a) Attach a reflective strip approximately 25mm (1 in) long to the back of the tape in the required position. (See Chapter 2 para 36).

(b) Spool towards the marker strip. The recorder will select the STOP mode when the marker is sensed.

(c) Check correct operation for both directions of tape movement and verify that both EOT and BOT sensors are sensing their appropriate markers.

(d) Suitable reflective marker strips are available from 3 M's Company (Sensing Markers No 650).

34. Removal of Headplate.

(a) Remove top cover, and facia (see paras 11 and 12 above).

(b) Remove head cover (one screw).

(c) Remove lid of Preamplifier screening can.

(d) Unplug the Replay head cables from the Replay Preamplifiers and the Record head cables from the Bias Oscillators.

(e) The headplate is in one piece and can be removed by loosening the three retaining screws.

(f) The record and replay heads are critically positioned and must not be removed from the headplate.

(g) Refitting is the opposite of the above, the following points being noted:-

(i) Ensure that the machined pads are scrupulously clean.

(ii) After replacing the head cover, check that it does not foul the tape.

(h) The surface finish on the heads is extermely fine and nothing must be allowed to touch the heads which will impair this finish. (A recorder with damaged heads is useless).

(j) Clean the heads thoroughly before use (para 2 above).

Pushbutton Assembly

35. To replace the indicator lamps see para 28 above. To remove the assembly proceed as follows:-

(a) Remove facia and top cover.

(b) Unplug the cable from the Deck Control Board.

(c) Extract the two screws securing the Pushbutton Assembly bracket to the deck casting and remove assembly.

(d) The assembly is connected to the remote socket, and therefore cannot be removed completely without unsoldering the connections.

(e) When replacing reverse the procedure. Before tightening the screws securing the Pushbutton Assembly bracket to the deck casting, the top cover should be offered to the equipment and the Pushbutton Assembly centralised. (See para 9 (e)).

Speed Selector Assembly.

36. To replace the record indicator lamp see para 28 above. To remove the assembly proceed as follows:-

(a) Remove facia and top cover.

(b) Unplug the selector cable from the Capstan Board.

(c) Extract the two screws securing the Speed Selector bracket to the deck casting and remove assembly.

(d) The assembly is connected to the remote socket and therefore cannot be removed completely without unsoldering the connections.

(e) When replacing, reverse the procedure. Before tightening the securing screws the top cover should be offered to the equipment and the Speed Selector Assembly centralised (see also para 9 (e)).

Spool Motor Assembly.

37. The spool motors are precision assemblies, and should not be dismantled. If a fault develops the complete unit must be replaced.

38. Spool Assembly Replacement.

(a) Remove facia (para 12 above).

(b) Disconnect Spool Motor. The motor wires (pink and black) plug into a terminal block near the tension arms.

(c) To gain access to the spool assembly securing screws, the brake assembly should be loosened and moved aside (see para 26) and in the case of the left hand spool assembly the bias boards also will have to be loosened and moved aside (see para 21).

(d) Remove the three motor securing screws and the facia support pillar.

(e) Withdraw the assembly while feeding wires behind the deck casting (it is not necessary to remove the hub).

(f) A socket screw secures the spool hub collar to the motor (3mm key).

(g) Reassembly is the reverse of the above. If the spool hub collar has been removed from the motor, adjustment will be required as in para 39 below.

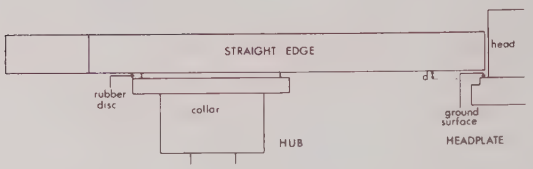
39. Spool Hub Height Adjustment. Adjustment will normally be necessary only after a spool assembly has been replaced. Proceed as follows:-

(a) Remove facia and head cover (para 12 above).

(b) Remove spool hubs. This is done by first removing the central screw (use special tool, P15358) and removing the top portion of the hub . (Note that there are usually 2 or 3 waved washers in the central screw recess which must be preserved for replacement on reassembly). Three pan head pozidriv screws are now accessible and must be removed to allow the lower half of the hub assembly to be detached.

(c) Lay a substantial straight edge across the rubber disc as shown in the diagram below. One end of the straight edge should be over part of the ground surface of the headplate, near the head nearest the rotating guide. Take care not to touch the head faces.

(d) Measure (with slip gauges or depth gauge), the distance 'd' as illustrated below. Rotate the hub and take the overage value of 'd' (it will vary slightly).



(e) If necessary adjust the height of the collar by slackening the socket screw (3 mm key).

(f) Factory adjustment of 'd' is to 4.71 mm ±0.1 mm (0.186 ± .0003 in) for the spools supplied. (T = 18.08 mm).

(g) If the tape touches the edge of the spool when the recorder is in normal operation, and the hub height is correct, check that the tension arm rollers are vertical. If this is not so, replacement of the Tension Arm Assembly is necessary.

Tension Arm Assembly

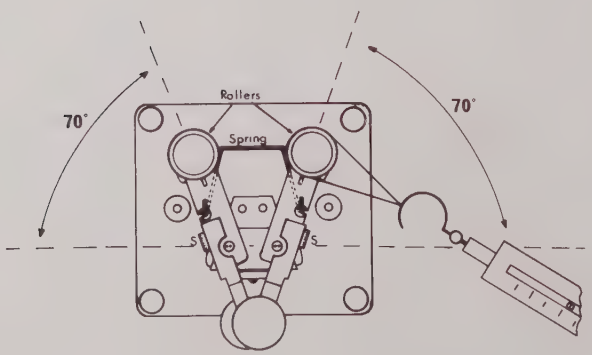
40. The assembly may be checked and adjusted as described in this paragraph and paras 41 - 43 below.

(a) Remove facia (para 12)

(b) Check rollers spin freely.

(c) Pull the L.H. roller until the arm touches the outer end stop, then release. The bearings are oil filled. The arm should return to the inner stop quickly and smoothly with a damped action. Repeat for R.H. arm.

(d) The oil filled assembly must not be disturbed. If faulty, the complete assembly must be replaced.



41. Tension Adjustment Attach a spring balance to one tension arm (see diagram). Hold the other arm at an angle of 70° as shown in the diagram and pull the spring balance until the other arm is also at an angle of 70°. The balance should read between 125 and 135 gf (4.4 to 4.7 ozf) (but see para 42). If the reading is outside the above range, reset by carefully adjusting the two innermost bends in the spring until a reading in the centre of the range is obtained.

42. Tension Change for thin tapes. The spring tension must be altered for tapes which are thinner than 26 µm. To do this remove the red spring and replace it with the black spring which is clipped on the side of the tension arm assembly. The spring tension as measured in para 41 above should then read betwen 70 and 80 gf (2.5 - 2.9 ozf).

43. Photocell Checks. The tension arms move shutters in front of a lamp to alter the light intensity falling on the photocells housed in the assembly. The operation can be checked as follows:-

(a) Remove base cover.

(b) Measure the voltage between TP1 and TP15 (TP1 at approximately +5 V) on the Spool Servo Board.

(c) Measure the voltage between TP2 and TP15 while swinging the R.H. tension arm between the end stops. The voltage swing should be between 20% and 80% of the voltage measured in (b) and at 50% when the arm is midway.

(d) Repeat (c) for the L.H. arm and the voltage between TP3 and TP15.

44. If no voltage swing is apparent, check that the bulb is illuminated by removing the assembly (para 45 below). If the bulb is functioning the entire photocell assembly must be replaced. (Individual photocells must not be removed from the boards since damage will result from overheating the photocell).

45. If the swings measured are incorrect, the shutter (at rear of Tension Arm Assembly) requires adjustment as detailed below, however as these adjustments are critical to the correct operation of the equipment, it is strongly recommended that they are performed by the Manufacturer or Agent.

(a) Slacken the socket screw S (use 2.5mm socket key).

(b) Hold the arm in mid position and turn the shaft, using the special tool (manufacturers reference number Cat 2c 2) inserted in the two drive holes until the voltage reads 50% of the value measured in para 43. DO NOT turn the shaft beyond the point where the shutter hits the photocell board.

(c) Tighten the socket screw ensuring that the arm is pushed down against the circlip on the shaft.

ALIGNMENT OF SIGNAL CIRCUITS.

46. Certain checks on the functioning of the signal circuits can be carried out using the monitor meter as described in Chapter 2 para 85 to 88. The full re-alignment procedure is outlined in the paragraphs 47-66 below.

Alignment of Dual Standard F.M. Channels.

47. The Dual Standard F.M. Electronics can be set up without recourse to test instruments. Greater accuracy can be achieved with the aid of a digital voltmeter.

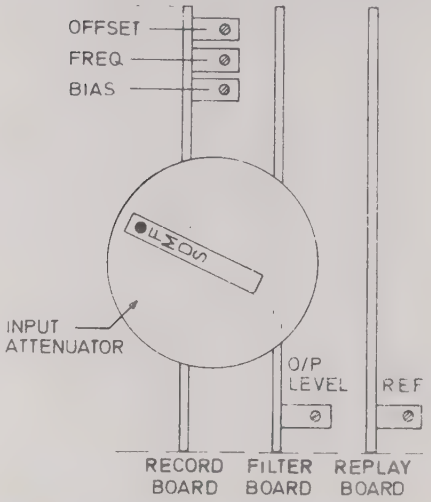
48. Alignment Procedure without external instruments.

(a) Ensure that switches 1,2,3 and 4 on the Record Board and switches 1 and 2 on the Filter Board are open circuit, i.e. pushed away from the direction of the arrow head.

(b) Select Intermediate Band operation with the switch labelled w.b.1. under the front flap. Push the switch away from the w.b.1. position.

(c) Switch the equipment "ON" and set the speed selector to 60 in/s, (tape does not have to be loaded).

(d) Perform the functions listed in the table under "Normal Alignment Procedure".



49. Alignment Procedure using a digital voltmeter. Greater accuracy can be achieved if a digital voltmeter is used. Initially carry out the procedure in para 48 above. On completion of this connect a digital voltmeter to the output of the channel concerned and carry out the procedure listed at the top of page 29.

NOTE: Alignment cannot be performed when using external speed control.

50. Output Level (V out) For test purposes this is normally set at 1 volt out for 1 volt in. Select "+" on the channel attenuator, connect a digital volt meter to the output BNC and adjust to 1.00 volts by means of the Output Level control.

Normal Alignment Procedure.

	Meter Selector position on required channel	Input Attenuator position (no input)	Potentiometer to be adjusted See diagram above		Result on Mete. (d.c mode)
			Identification	P C Board	
	REC	+	no adjustment		check for +fsd
-	REC	-	no adjustment		check for -fsd
	REP	REF	REF	replay	adjust to ref mark
4	REP	60	FREQ	record	adjust for zero

If the results set out in this table are not achieved it is possible that there is a Signal Board fault. Reference to the trouble shooting tables in Appendix B should help eliminate this.

Alignment Procedure using Digital Voltmeter.

Step	Operation	Input Attenuator position (no input)	Potentiometer to be adjusted		Reading on Digital Voltmeter
			Identification	P.C. Board	
1	Set approx. output level	'+'	OUTPUT LEVEL	filter	+V out*(e.g. 1V)
2	Set demodulator	'REF'	'REF'	replay	-18.5%V out (e.g. -185 mV)
3	Set centre carrier	'20V'	'FREQ'	record	0 V
4	Set output level	'+'	OUTPUT LEVEL	filter	+V out (e.g. 1V)

* V out is the output voltage required for a full scale positive input, and can be adjusted within the range 0V to 3V.

51. Bias Adjustment. Re-adjustment of the bias control will be necessary on the following occasions:-

(a) Change of headplate.

(b) Change of bias board.

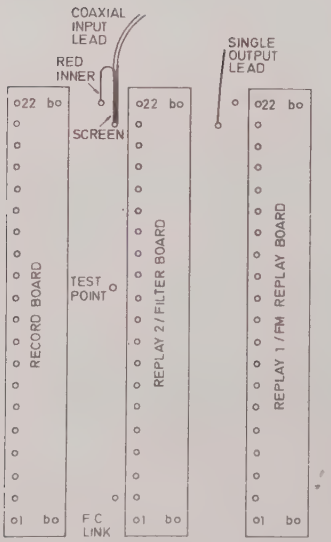
(c) Change of "tape type".

(d) On acquiring signal boards not previously used in an equipment.

52. The bias level may be adjusted as follows:-

(a) Disconnect power to equipment, remove base cover, and connect monitor probe to pin 1 of the Replay Board socket, (see illustration below).

(b) Connect monitor probe to an oscilloscope, load equipment with tape of the type to be used. Preferably tape should be bulk erased.



VIEW OF UNDERSIDE OF MOTHERBOARD SHOWING PRINTED CIRCUIT BOARD SOCKETS.

(c) Switch on equipment, set speed selector switch to $7\frac{1}{2}$ in/s, set bandwidth switch to wideband 1 (w.b.1), under the front flap.

(d) Set attenuator control of channel concerned to "+" position.

(e) Set equipment in motion by selecting forward record.

(f) Adjust BIAS control (see illustration on page 28) for maximum output.

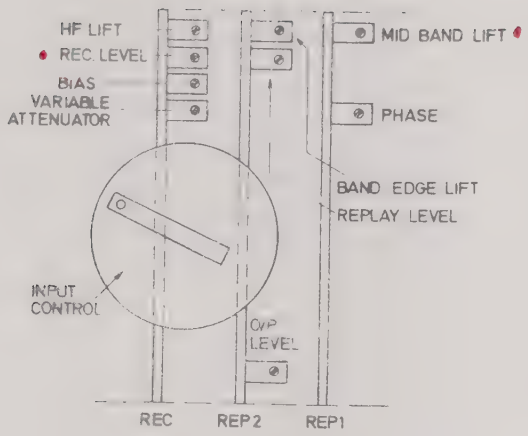
53. Offset Adjustment. The OFFSET control, selected by switch 3 on the Dual Standard Record Board can be used to reduce to zero any d.c. input level within the range ±20 volt.

Alignment of D.R. Channels.

54. D.R. signal boards are aligned, as a set of three, for a particular signal channel. If the boards are mixed with other sets, or put in a different channel slight changes in the phase/amplitude frequency responses may occur.

55. If due to mixing of boards, or on acquisition of a new set of boards it is felt that the channel response is not satisfactory, then a set can be adjusted as set out in the paragraphs below. Re-alignment may be necessary also if the equipment is used with a different tape type.

56 Alignment Procedure. Test equipment required:- Signal Generator (sine and square wave outputs up to 300 kHz), Valve Voltmeter, Oscilloscope, Spectrum Analyser or Wave Analyser (if this item of equipment is not available alignment is still possible but the record level necessary for the specified -40 dB third harmonic distortion can be approximated only.) (See para 64 (f) below).



57. For the channel under test, set the controls as follows:-

(a) On the Record Card set "RECORD LEVEL" and "BIAS" fully anticlockwise.

(b) On the Replay 1 card set "MID BAND LIFT" fully anticlockwise, then rotate 12 turns clockwise.

(c) On the Replay 2 card turn "BAND EDGE LIFT" fully anticlockwise, then 12 turns clockwsie, turn "REPLAY LEVEL" fully clockwise.

NOTE: All voltage levels quoted below in dB are relative to 775mV (0 dBm on most valve voltmeters) except where otherwise stated.

58 (a) Set input attenuator to 1V position.

(b) Connect signal generator to the channel input, and set to 707mV (-0.8dB) at 1kHz sine wave.

(c) Set "O/P LEVEL" to give an output of 0dB. The tape should be stopped - i.e. in the "E - E" mode.

59. (a) Set input frequency to 37.5kHz.

(b) Record forward at $7\frac{1}{2}$ in/s and monitor the signal output. (The rest of the alignment procedure is performed in the "Forward Record" mode).

(c) Turn "BIAS" clockwise until the output is at maximum. Note the output level.

(d) Turn "BIAS" further clockwise until the output falls 3dB below the level measured in (c).

60. (a) Set input frequency back to 1kHz.

(b) Turn "REC LEVEL" clockwise to give 0dB output.

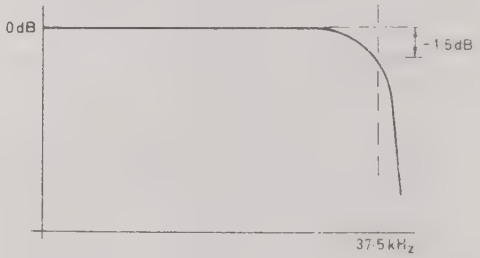
61. (a) Set input frequency to 10kHz.

(b) Adjust "MID BAND LIFT: to give an output of 0 dB.

62. (a) Set frequency to 37.5kHz.

(b) Adjust "BAND EDGE LIFT" to give an output of -1.5dB.

(c) Sweep the frequency over the entire bandwidth and check that the response measured at the output is similar to the one shown below.



(d) Repeat paras 60 to 62 until no further adjustment is necessary.

63. (a) Set frequency to 3.75kHz, 2V peak - to - peak square wave.

(b) Adjust "PHASE" to give the best square wave output.

These overshoots to be of same amplitude.

64. (a) Monitor the channel output with a Spectrum Analyser or Wave Analyser (if not available see (f) below). Set Analyser to 5kHz/div, 100Hz bandwith.

(b) Set input to 15kHz sine wave at -0.8dB. Select 30 in/s (forward record).

(c) Adjust "REC LEVEL" so that the third harmonic distortion is -40dB with respect to the fundamental (15kHz).

(d) Select $7\frac{1}{2}$ in/s. Set frequency to 1 kHz. Adjust "REPLAY LEVEL" for 0 dB output.

(e) Repeat (b) to (d) until no further adjustment is necessary.

(f) If an analyser is not available omit steps (a) to (e); select $7\frac{1}{2}$ in/s and set frequency to 1 kHz sinewave at -0.8 dB. Adjust "REC LEVEL" to give an output of +2 dB. Adjust "REPLAY LEVEL" for 0 dB output. This will give approximately -40 dB third harmonic distortion.

65. (a) Set frequency to 37.5 kHz, sine wave -0.8 dB. Record at $7\frac{1}{2}$ in/s for approximately 60 feet (the tape position indicator measures in feet).

(b) Rewind and replay in the same direction at 60 in/s. Note the signal output level.

(c) Record a 300 kHz -0.8 dB sine wave at 60 in/s and adjust "H.F. LIFT" while recording until the output level is the same as in (b).

66. When the above alignment procedure is complete, the "OUTPUT LEVEL" can be set to 1 volt peak (-0.8 dB) which is the normal setting. Alternatively the output may be set to any value within the range 0 to 3 V peak for the full rated input.

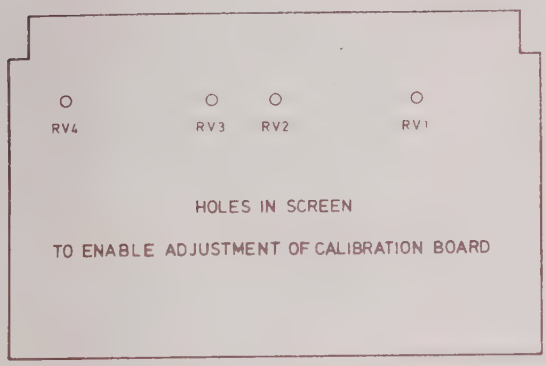
Alignment of Calibration Board.

67. The accuracy of the amplitude of Calibration Board signals is specified as ±2%. To ensure that this accuracy is maintained the board should be re-aligned at intervals of not more than one year.

68. Procedure Stand the equipment on its rear casting. Remove base cover and proceed as follows:-

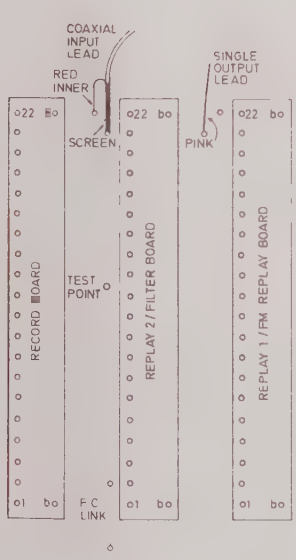
(a) Monitor +9 volt and -9 volt on the Motherboard with respect to the 0 V test point. Both 9 volt rails should be set to 9.00 volt by means of RV1 and RV2 respectively, on the Deck Control board.

(b) Select $\frac{15}{16}$ in/s (tape does not have to be loaded); set Channel 1 input control to "+" (band-edge calibration signal) and all others to OFF.



(c) Monitor output BNC socket of Channel 1 with counter and oscilloscope. Signal should be a sine wave with no visible distortion. Adjust RV1 on Calibration Board to give a frequency of 4,750 Hz ±5 Hz. Check that the output frequency at other speeds lies between the following limits.

Speed in/s	Frequency (kHz)
60	285 - 315
30	142.5 - 157.5
15	71.2 - 78.75
$7\frac{1}{2}$	35.5 - 39.2
$3\frac{3}{4}$	18.1 - 19.9
$1\frac{7}{8}$	9.1 - 9.9



VIEW OF UNDERSIDE OF MOTHERBOARD SHOWING PRINTED CIRCUIT BOARD SOCKETS

(d) Monitor pin 22b on any Record Board socket with respect to 0 V on the Motherboard. If using a Hewlett Packard 400E set range switch to 100 mV, and connect digital voltmeter to the d.c. output of the a.c. voltmeter. Adjust RV2 on the Calibration Board for a reading of 707 mV on the digital voltmeter. On completion disconnect the a.c. voltmeter.

(e) Select $\frac{15}{16}$ in/s and set Channel 1 input control to "-" ($\frac{1}{10}$ band-edge calibration signal) and with the counter and oscilloscope still connected to Channel 1 output BNC socket, adjust RV3 on the Calibration Board to give a frequency of 475Hz ± 0.5Hz. Check that the output frequency at other speeds lies between the following limits.

Speed (in/s)	Frequency (kHz)
60	28.5 - 31.5
30	14.25 - 15.75
15	7.12 - 7.87
$7\frac{1}{2}$	3.55 - 39.5
$3\frac{3}{4}$	1.81 - 1.9
$1\frac{7}{8}$	0.901 - 0.99

(f) Monitor pin 1b on any Record Board socket with respect to 0 V on the Motherboard with a.c. voltmeter and digital voltmeter as in para 68 (d). Adjust RV4 on the Calibration Board for a reading of 707 mV on the digital voltmeter.

(g) Switch off and remove test equipment, replace any signal boards that have been removed, signal board retaining bar, top cover and flap. (The top of the Calibration Board locates on the lower front edge of the top cover). Replace the base cover.

Variation of Alignment with Tape Speed.

69. The F. M. and D.R. circuits incorporate switches which select equalization circuits to ensure that, once aligned at a particular speed, the alignment is correct for all other standard speeds. If non-standard speeds are used (e.g. external speed control) then the alignment is likely to be incorrect.

70. External Speed Control (See Chapter 2 para 69). Although the tape speed can be varied over the range 0.45 to 90 in/s the signal channels are aligned for the seven discrete speeds from $\frac{15}{16}$ to 60 in/s. Operation of a F.M. channel at other speeds will cause D.C. offsets and gain changes which are proportional to the ratio of the record and replay speeds.

71. Operation of D.R. channels at different speeds will affect the frequency response equalization although the mid band gain will be unaffected.

Wiring Configuration

72. Colour coding of Interconnecting wires. When interconnections between sub-assemblies are made via discrete wires (i.e. not flat-strip cables), the wires are normally numbered to correspond with the pin numbers they connect. The wire number is expressed in the form of a colour code as follows:-

(a) Wire No.

0	=	Black
1	=	Brown
2	=	Red
3	=	Orange
4	=	Yellow
5	=	Green
6	=	Blue
7	=	Violet
8	=	Grey
9	=	White

(b) Wire Numbers 10 to 99 are basic pink wire overprinted with spiral coloured stripes, the first figure is indicated by two stripes the same colour, and the second figure by a single stripe e.g. Wire No.21 is a pink wire overprinted with two Red stripes and one Brown stripe; wire No.55 is a pink wire overprinted with all Green stripes.

The wires which are numbered in the figures in Chapter 5 follow the above code.

73. Numbering of Flat-Strip Cableforms. Many of the interconnections between sub-assemblies are in the form of Scotchflex strip cableform. The wires are numbered according to the plug/socket pin number to which they connect. Counting across the strip from the red edge the wires are numbered as follows:- 14, 1, 13, 2, 12, 3, 11, 4, 10, 5, 9, 6, 8, 7.

CHAPTER 5

TECHNICAL INFORMATION

PRESENTATION

1. To provide technical information relating to the equipment as concisely as possible, this Handbook employs an illustrative format. A written description of the operation of each sub system will be found in the block diagrams, while the comprehension of individual circuit operation is aided by splitting the circuit diagram into coloured functional areas supplemented by captions.

2. Figure 1 shows the relationship between the basic controls and the systems within the equipment. Figs 2 - 5 describe the operation of the three main sub systems, namely record/replay, tape transport and power supply circuits. The Block Diagrams also act as an index for the individual circuit boards they describe.

3. The signal circuits are arranged where possible in an order which follows the signal path from input to output. Later circuits cover transport and power circuits respectively.

4. In most cases the board layout and parts list are presented on the page facing the appropriate circuit diagram, providing complete information about the board at one opening of the Handbook.

5. The equipment interconnection diagrams and main parts lists are included at the end of the Chapter.

6. The logic cymbols in this Handbook comply with BS3939. Fig.4 gives the equivalent symbols to Mil - STD - 806B for users who are accustomed to the latter standard.

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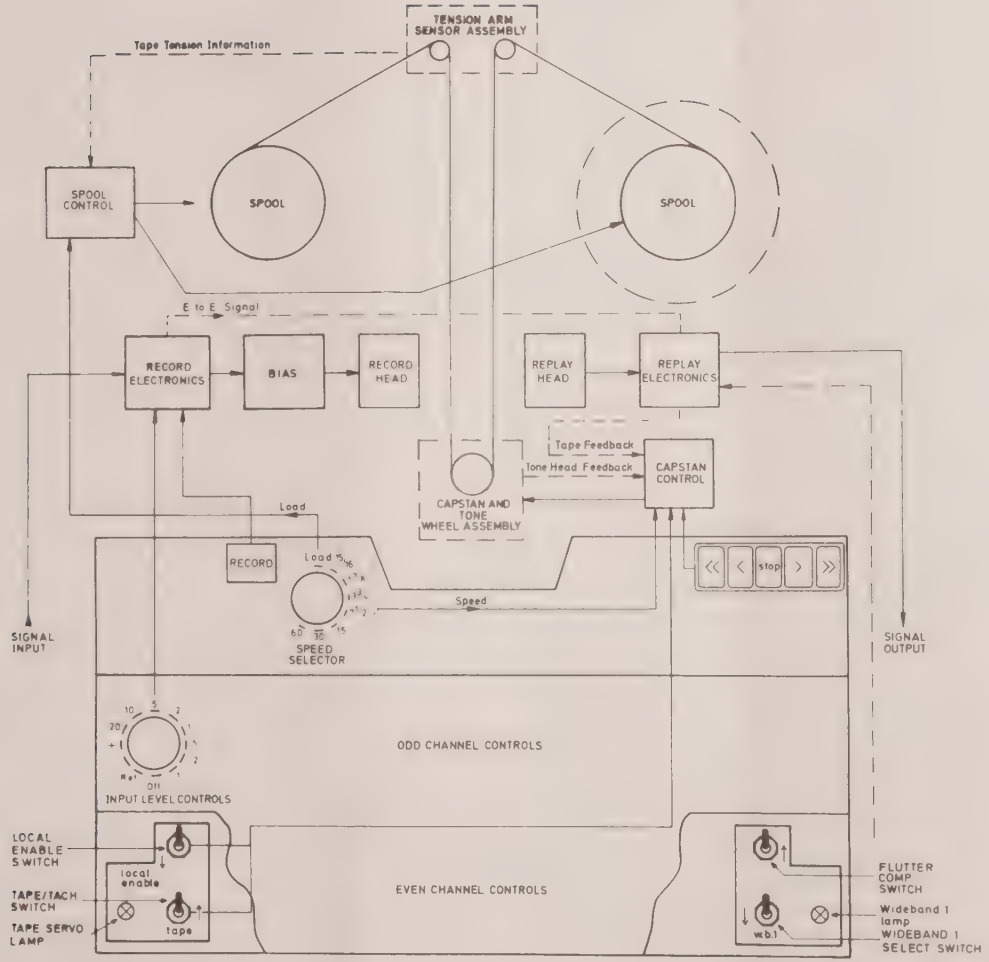

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FIG. 1
GENERAL
BLOCK DIAGRAM

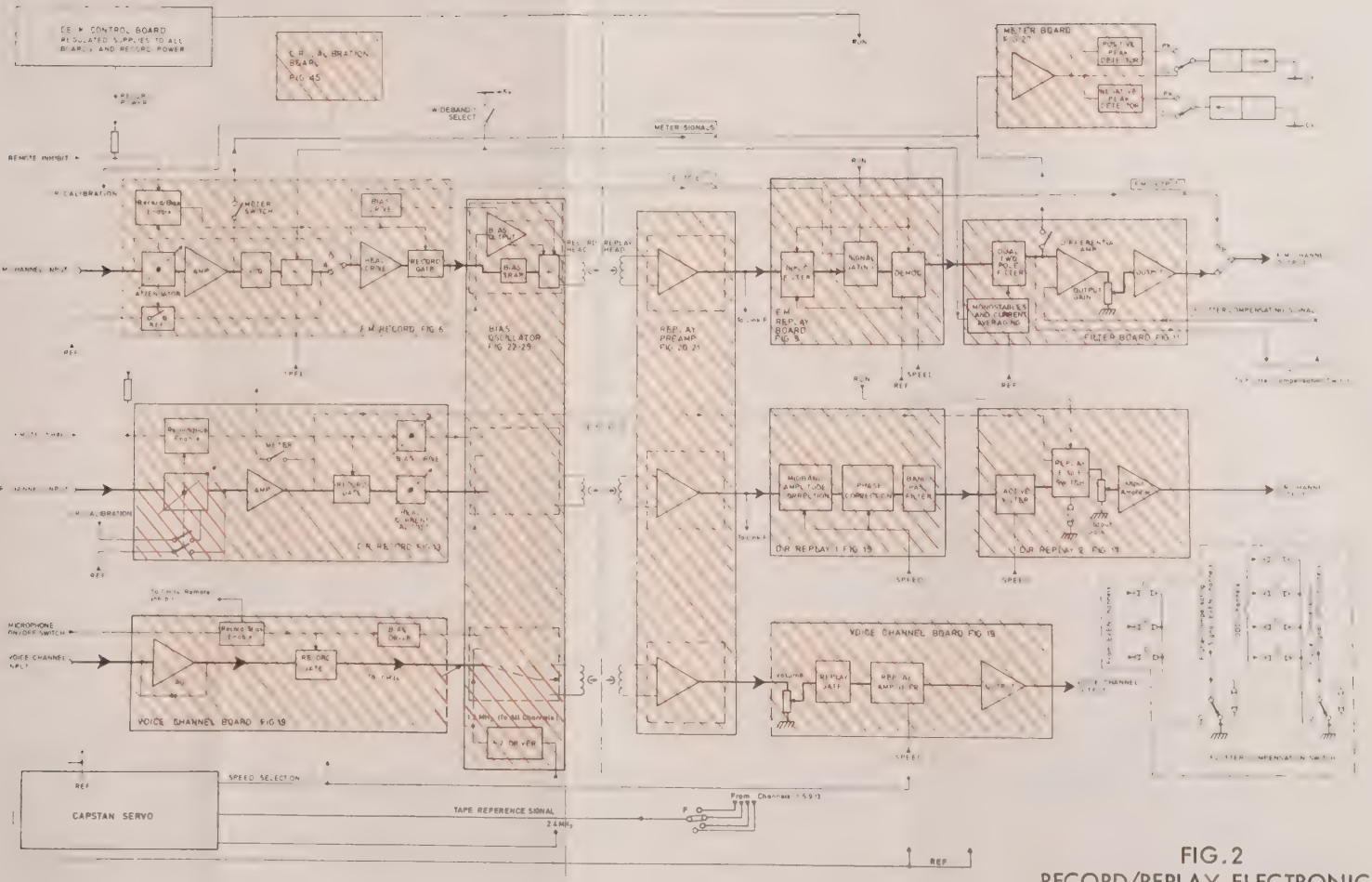

FIG. 2
RECORD/REPLAY ELECTRONICS
BLOCK DIAGRAM

Store 14 DS
Match +1

D R CALIBRATION BOARD
Fig 5?

Generates signals at X1 and X0.1 bandedge frequency controlled by speeds lines. Signals are fed to D R Record board and selected by + and - on the attenuator switch

METER BOARD (Fig 27)

An input buffer amplifier drives a pair of peak detector circuits, one connected in the inverting mode for negative peaks and the other connected in the non-inverting mode for positive peaks. Diodes are used to prevent excessive input voltages causing damage to the meter

DUAL STANDARD F.M. RECORD BOARD (FIG 7)

The input signal is fed to a virtual earth input amplifier The input attenuator control adjusts the feed back of this amplifier to give maximum inputs as given in Chapter 2. The input amplifiers feed into a current controlled oscillator the output of which is conditioned by speed lines and whether or not wideband 1 is required. The output from the head drive amplifier passes through 'transmission gates', and then to the bias board

The attenuator control can be switched to "+" or "-". This will provide calibration signals at +40% and -40% deviation. If the attenuator control is switched to REF a reference tone is recorded on tape for use in tape servo mode When the control is set to "off" all Record Drive and Bias Drive outputs are inhibited

Link A can be changed to allow direct recording of F.M. or TTL input signals

BIAS OSCILLATOR
Fig 22-25

The 2.4MHz signal from the Capstan servo is divided by two and a 1.2MHz signal fed to each channel's push-pull output. Bias output level for each channel is controlled by the Bias Drive on the corresponding Record board. The record signals are added to the bias signal via bias trap, the combined signal being fed to the Record Heads

REPLAY PREAMPLIFIER BOARD
(Fig 21)

Each replay head output feeds into identical preamplifiers. Each has a balanced low impedance input and a gain of approximately 100dB at 30Hz, falling at 6dB/octave. [illegible] for the replay characteristic

DUAL STANDARD F M REPLAY BOARD (FIG 9)

The Replay Pre-amplifier output is passed into a high pass amplifier. This amplifier is fed with a variable current proportional to reference frequency. The signal then splits two ways, one to a threshold detector and the other to a crossover detector. After E to E switching (operated by run time) the signal passes to a squelch detection circuit where a lack of signal will operate the squelch switch

Speed and Wideband 1 or Intermediate Band information is fed into the pulse counter which is used to gate the Gated Oscillator. Output from the replay boards consists, at 60 in/s wideband 1 of a monostable waveform containing one oscillator waveform, at 60 in/s intermediate band or 30 in/s wideband 1 two oscillator waveforms will be enclosed and pro-rata for all ranges. An output impedance of 1k5 is presented to the F.M. Filter Board

DUAL STANDARD F M FILTER BOARD
(FIG ??)

The signal from the Dual Standard Replay Board is averaged by a 24dB/octave low pass filter. The bandwidth is determined by reference frequency and whether or not wideband 1 is selected. Flutter compensation is achieved by subtracting the flutter compensation signal from the channel signal Unipolar restoration is selected by means of S1 or S2. The output stage incorporates a low pass filter to eliminate high frequency elements still remaining

D R RECORD BOARD (Fig.13)

The input signal is fed via an input attenuator to the Record amplifier. Record Drive and Bias Drive outputs are inhibited if the Record Power line is LO. (I.e. the Record button has not been depressed), If the Remote Inhibit line is LO, or for OFF

The REF attenuator position allows recording of a reference signal for subsequent speed control during replay in the Tape mode. The + and - positions select calibration signals from the Calibration board. Frequencies are upper band edge (+) and ⅛ of band edge (-)

The Bias Drive controls and provides adjustment of bias level on the Bias board.

Signals are taken from pin 3 and fed to an overload detector to check the amplitude of the applied signal

D R. REPLAY 1 (Fig. 15)

The signal from the Replay Preamplifier pass through two amplifiers which provide midband amplitude correction and phase correction respectively. The circuits are switched by the speed lines as the correction required depends on the tape speed selected. Fine adjustment controls are included which once set for one speed are correct for all other speeds.

The signals pass to the D R. Replay 2 card via a band pass filter of:-

(I) 100 Hz to 300 kHz
(II) 50 Hz to 300 kHz.

according to option requirements.

D R REPLAY 2 (Fig 17)

Signals from Replay 1 go via a preset level control to an active filter. Feedback provides high gain at the upper band edge to compensate for head tape losses. The feed back is switched by the speed lines, and once adjusted for a given speed is automatically correct at all other speeds

The Replay E to E Switch selects either the above signal, or the E to E signal direct from the D R Record board, and depends on the status of the Run line Link C inhibits the E to E mode

The selected signal passes to the Output amplifier and thence to the Signal Output socket

VOICE CHANNEL BOARD (Fig.19)

The output from the microphone unit is fed to the Record amplifier. An A.G.C. circuit ensures correct recording level. The output is fed to the Bias board via the Record Gate which is enabled by the microphone Talk switch. Depressing the Talk switch also enables the Bias Drive

Voice recordings can be made during replay

VOICE CHANNEL BOARD (Fig 19)

The output from the Replay Preamplifier passes via the Gain (Volume) control to the Replay Gate. Signals are allowed through when the "TALK" switch is not depressed, and pass to the Replay Amplifier which drives the push-pull output to the microphone/loudspeaker unit.

A Frequency Response Equaliser gives H.F. lift at ¾ in/s.

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FIG.2a
RECORD
REPLAY
ELECTRONICS

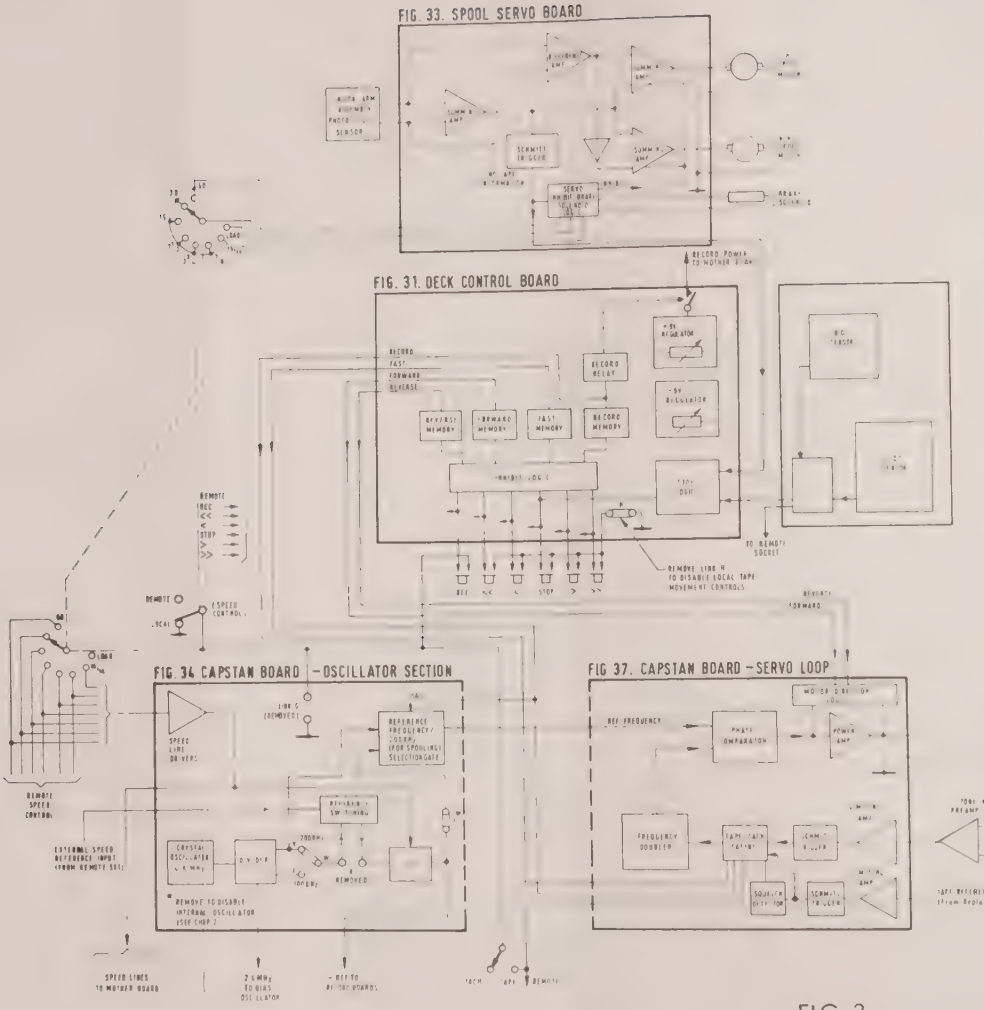
FIG. 33. SPOOL SERVO BOARD
FIG. 31. DECK CONTROL BOARD
FIG. 34 CAPSTAN BOARD - OSCILLATOR SECTION
FIG 37. CAPSTAN BOARD - SERVO LOOP

FIG.3
TAPE TRANSPORT - BLOCK DIAGRAM

SPOOL SERVO BOARD (Fig.33)

The tension arm assembly output voltages are proportional to their respective arm positions. The Spool Servo board processes these voltages to provide total and differential tension parameters, which are then combined in the Spool Power amplifiers to provide the motor drive currents. The above process is carried out in summing and differential amplifiers.

The total tension parameter is monitored, and if it falls below a defined level, Stop is commanded, the brake solenoid released (i.e. brakes on) and the Spool Motor Power amplifiers disabled. Resetting is accomplished by turning the speed switch to LOAD.

DECK CONTROL BOARD (Fig.31)

Provides logic and memory circuits for encoding control signals, also decoding logic and drivers for the push-button lamps.

Circuits select the Stop mode when the equipment is switched on, also on receipt of an EOT or BOT signal.

Link H is removed when remote control of the command push-button functions is required.

The +9V and -9V regulators share the board.

CAPSTAN SERVO BOARD

OSCILLATOR SECTION (Fig. 34).

The 4.8MHz crystal oscillator frequency is divided to give an output of 2.4MHz for the Bias Oscillator and outputs of 200kHz and 100kHz for capstan speed control. When in the Run mode the 200kHz signal is divided according to tape speed selected (100kHz for 60 in/s, 50kHz for 30 in/s and pro rata). This divided reference is fed to the Record boards and also to the Servo section via the selection gate. In the Fast mode a 200kHz signal is fed to the Servo section. An External Speed Reference input will override the internal crystal reference; speed of equipment will be variable simply by changing its frequency. The Local/Remote switch in place of Link 'G' will facilitate disabling the local Record Button and Speed Selector when remote operation is required.

CAPSTAN SERVO BOARD

SERVO LOOP SECTION (Fig. 37)

During recording, the reference frequency from the Oscillator section is compared with the signal coming from the Tone Head. This Tach signal is amplified, squared up, and frequency doubled before comparison with the reference frequency in the phase comparator. This detects differences in phase between the two signals and drives the capstan motor accordingly to correct any error.

During replay the reference frequency can either be compared with the Tach signal (capstan speed) or Tape signal (tape speed) depending on the state of the control logic.

In the Fast mode the servo will attempt to achieve 120 in/s (for spooling) due to the 200kHz signal from the Oscillator section.

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FIG.3a
TAPE TRANSPORT

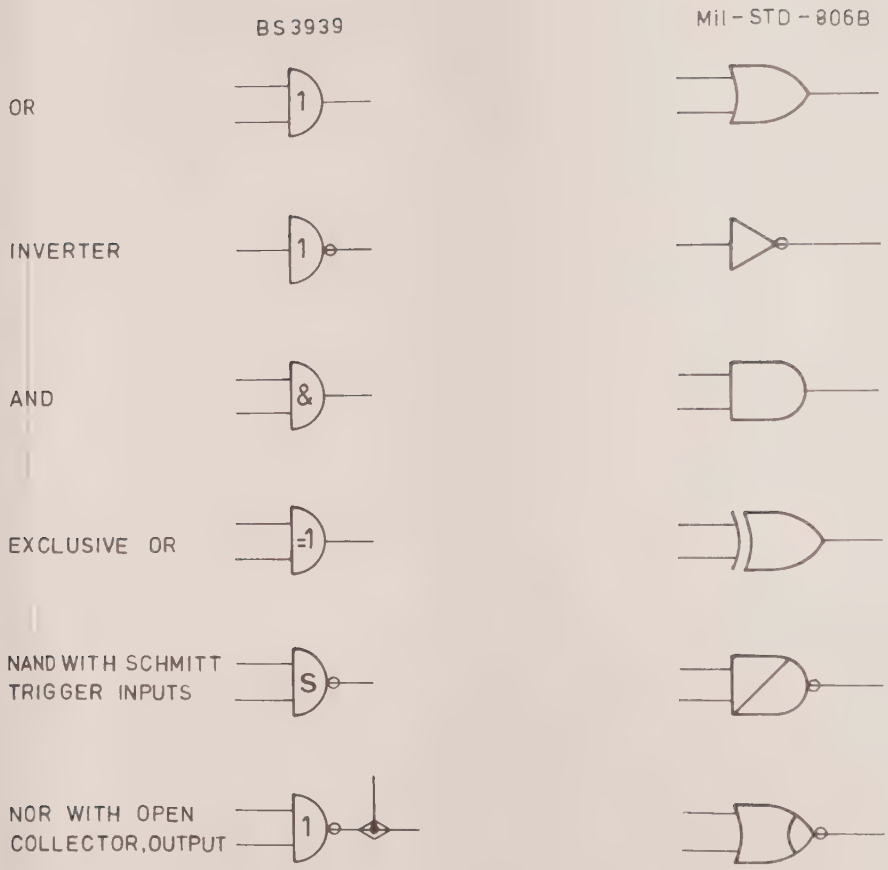
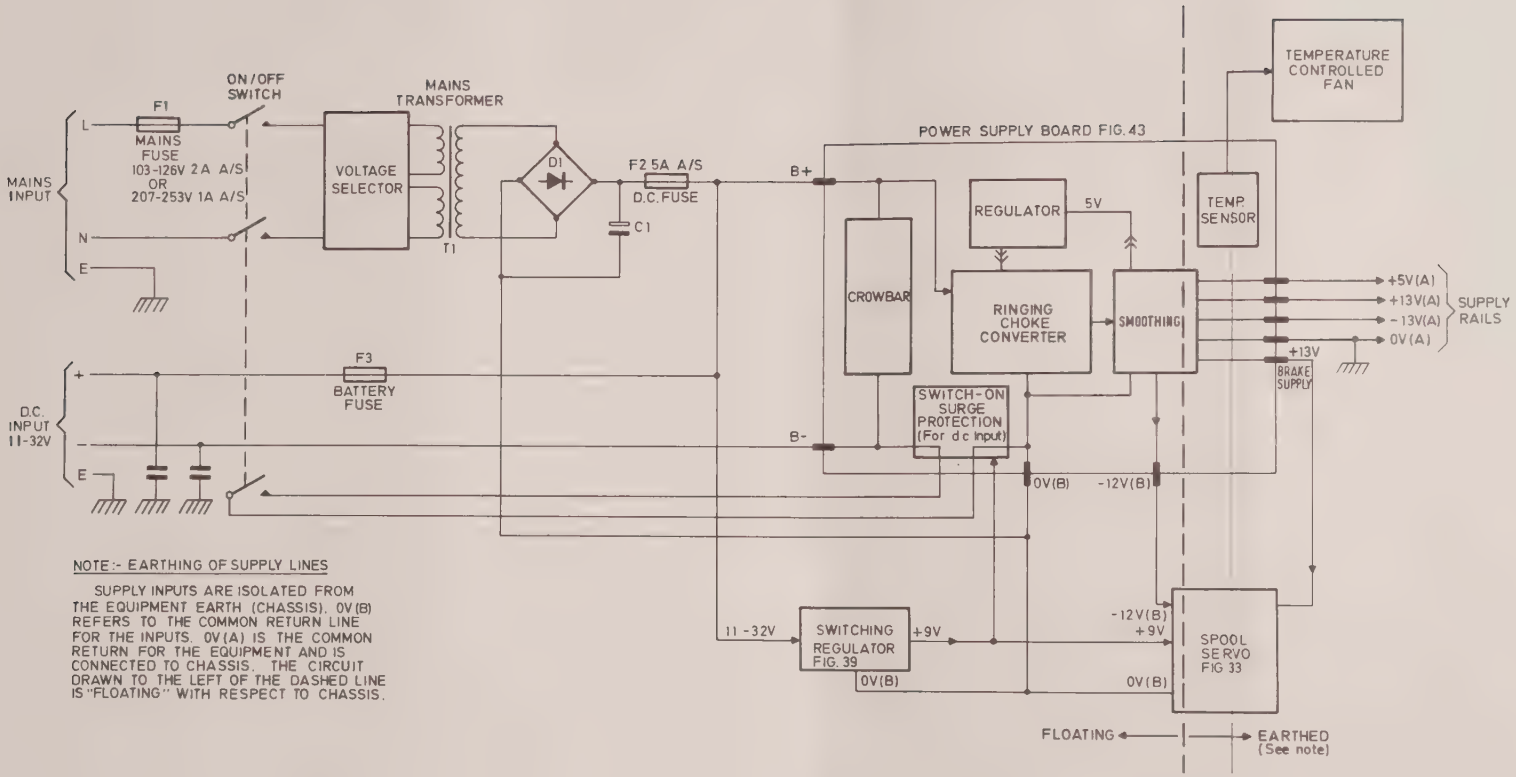


FIG. 4
B. S. - MIL LOGIC SYMBOLS



NOTE:- EARTHING OF SUPPLY LINES

SUPPLY INPUTS ARE ISOLATED FROM THE EQUIPMENT EARTH (CHASSIS). 0V(B) REFERS TO THE COMMON RETURN LINE FOR THE INPUTS. 0V(A) IS THE COMMON RETURN FOR THE EQUIPMENT AND IS CONNECTED TO CHASSIS. THE CIRCUIT DRAWN TO THE LEFT OF THE DASHED LINE IS "FLOATING" WITH RESPECT TO CHASSIS.

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POWER SUPPLY - BLOCK DIAGRAM - FIG.5

CIRCUIT REF	VALUE	TOL	RATING	MFRS. REF NO
	F.M. RECORD BOARD (Dual Standard)			D8920
Capacitors				
C1	220 pF	1%	400 V	Cat 15368
C2,14	22 pF	2%	63 V	Cat 10191
C3	0.01 µF	-20% +80%	100 V	Cat 13427
C4,15	1 µF	20%	35 V	C166109
C5,6,13	47 pF	2%	63 V	Cat 11615
C8	1000 pF	10%	100 V	Cat 12033
C9,10	33 µF	20%	16 V	Cat 163330
C11	47 µF	20%	10 V	C162470
C12 *	10 pF	2%	63 V	Cat 12030
C16	0.1 µF	20%	100 V	Cat 14546
C17	3300 pF	10%	100 V	Cat 13130
* Not required if AC is TLO 81CP				
Diodes				
D1-D16, D18-D20	BAX 13			Cat 8406
D17	Light Emitting Diode			Cat 14060
Knob				
1 off	F.M.D.S.			D7601/5
Integrated Circuits				
AA	CD4053B			S64 4053
AB	CD4010B			S64 0103
AC	TLO 81CP or RCA 3100S			Cat 14374 / Cat 11405
AD	CD4011B			S644011
AE	CD4013B			S644013
AF	CD4066B			S644066
AG	LF356N			Cat 14372
AH	RC4558			Cat 14373
Potentiometers				
RV1	50k Spectrol 43p			Cat 12420
RV2	500Ω Spectrol 43p			Cat 12409
RV3	1k Spectrol 43 p			Cat 11930
RV4	10k Spectrol 64W			Cat 14329

CIRCUIT REF	VALUE	TOL	RATING	MFRS. REF. NO.
	F.M. RECORD BOARD (Contd) (Dual Standard)			D8920
Resistors				
R1	2k2	5%	¼W	R10222
R4	3k3	5%	¼W	R10332
R5	100Ω	5%	¼W	R10101
R6	1k8	5%	¼W	R10182
R7,13	220Ω	5%	¼W	R10221
R8	2k2	2%	¼W	R30222
R9	10k	5%	¼W	R10103
R11	1k8	5%	¼W	R10182
R12	820	5%	¼W	R10820
R14,17	100k	5%	¼W	R10104
R15	22k	5%	¼W	R10223
R16	390	5%	¼W	R10391
R18	47k	5%	¼W	R10473
R19	4k7	5%	¼W	R10472
Resistor Arrays				
RU1				Cat 15230
RU2				Cat 15234
RU3				Cat 15232
RU4				Cat 15231
Screen				
	Switch Screen			P16745
	Screening Board			P16737
Switches				
S1-S4	D.I.L. Erg			Cat 15181
S5	Reed, Hamlin MSRR-220-30AT			Cat 11539
S6	Rotary, Attenuator			P15831
Terminal Assembly	Vero			Cat 13747
Test Probe Socket				Cat 2683
Transistors				
TR1,5	BC109B			Cat 15104
TR2	2N2369A			Cat 15105
TR3	MPS3640			Cat 13209
TR4	BC308			Cat 11977
TR6	ZTX 550			Cat 13629

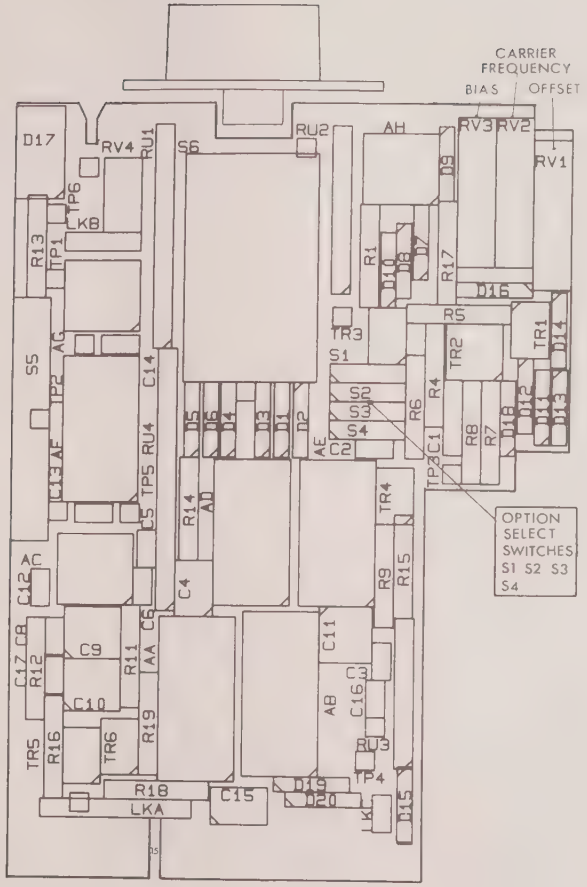
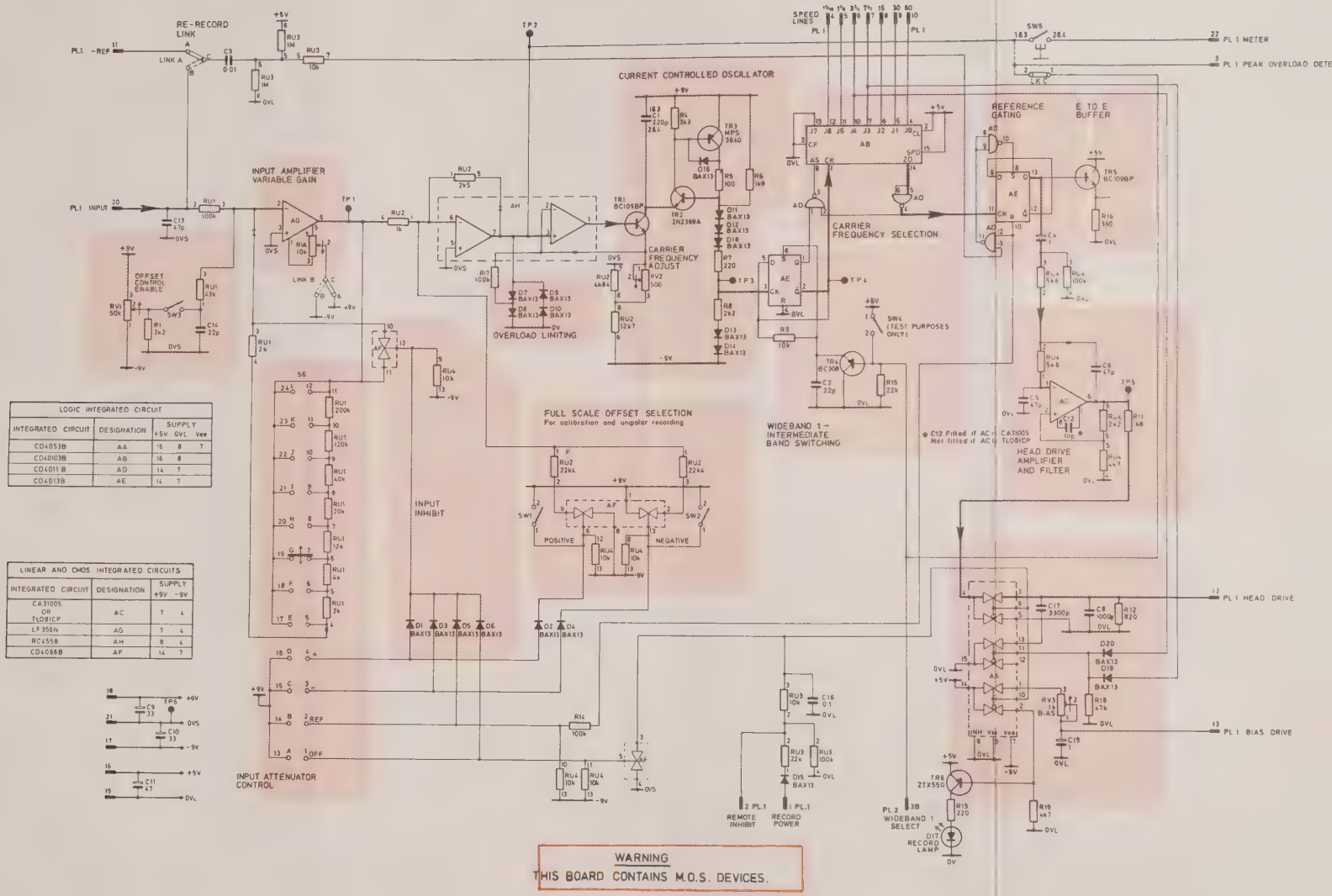


FIG.6 F.M. RECORD BOARD - LAYOUT (DUAL STANDARD) D8920



LOGIC INTEGRATED CIRCUIT				
INTEGRATED CIRCUIT	DESIGNATION	SUPPLY +5V	OVL	Vee
CD4053B	AA	16	8	7
CD4013B	AB	16	8	
CD4011B	AD	14	7	
CD4013B	AE	14	7	

LINEAR AND CMOS INTEGRATED CIRCUITS			
INTEGRATED CIRCUIT	DESIGNATION	SUPPLY +9V	-9V
CA3100S OR TL081CP	AC	7	4
LF356N	AG	7	4
RC4558	AH	8	4
CD4066B	AF	14	7

WARNING
THIS BOARD CONTAINS M.O.S. DEVICES.

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FIG.7
F.M. RECORD BOARD - CIRCUIT (DUAL STANDARD)

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	F.M. REPLAY BOARD (Dual Standard)			D8283
Capacitors				
C1,4	330 pF	2½%	30 V	Cat 12731
C2	2200 pF	2½%	30 V	Cat 12328
C3	220 µF	20%	3 V	Cat 13398
C6	47 µF	20%	10 V	C162470
C7	220 pF	2%	63 V	Cat 10357
C8,20	470 pF	10%	100 V	Cat 12032
C9	100 pF	1%	400 V	Cat 15367
C10	100 pF	2%	100 V	Cat 16003
C11	10 µF	20%	10 V	C162100
C12	2200 pF	10%	100 V	Cat 16001
C13,18	47 pF	2%	63 V	Cat 11615
C14,15,16	33 µF	20%	16 V	C163330
Diodes				
D1-7	BAX 13			Cat 8406
Integrated Circuits				
AA	CA3100S			Cat 11405
AB	LF357N			Cat 15387
AC	LM319K			Cat 14379
AD	SN74LS86N			Cat 11408
AE	SN74LS132N			Cat 14041
AF,AG	SN74LS193N			Cat 11409
AH	SN74221N			Cat 14386
AJ	SN74LS73N			Cat 14048
AK	SN74LS74N			Cat 15073
Potentiometer				
RV1	2k			Cat 11936
Resistors				
R1	2k7	5%	¼W	R10272
R2	3k3	5%	¼W	R10332
R3,14	560	5%	¼W	R10561
R4	15k	5%	¼W	R10153
R5,6,12,15, 18,22	470	5%	¼W	R10471
R7,8	8k2	5%	¼W	R10822
R9,16	10	5%	¼W	R10100
R10	56k	5%	¼W	R10563
R11	1k	5%	¼W	R10102

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	F.M. REPLAY BOARD (Contd) (Dual Standard)			D8283
Resistors (Contd)				
R13,38,41	4k7	5%	¼W	R10472
R17	12k	5%	¼W	R10123
R19,24,31, 32,33,40,42	10k	5%	¼W	R10103
R21	100k	5%	¼W	R10104
R23	47k	5%	¼W	R10473
R25	46k4	0.5%	¼W	Cat 15343
R26	18k	2%	¼W	R30183
R27	28k	1%	⅛W	R202802
R28	4R7	0.5%	¼W	Cat 15342
R29	14k	1%	⅛W	R201402
R30	1k5	2%	¼W	R30152
R34	1k5	5%	¼W	R10152
R21	5k1	2%	¼W	R30512
R36	5k6	2%	¼W	R30562
R37	100	5%	¼W	R10101
R39	2k7	2%	¼W	R30272
R43	1M	5%	¼W	R10105
Terminal Assembly				
TP1-7	Vero			Cat 13747
Transistors				
TR1,11	VN10KM (FET)			Cat 15101
TR2,3,4,9, 10	BC 237			Cat 11978
TR5	J112 (FET)			Cat 10540
TR6,7,8	J177 (FET)			Cat 13967

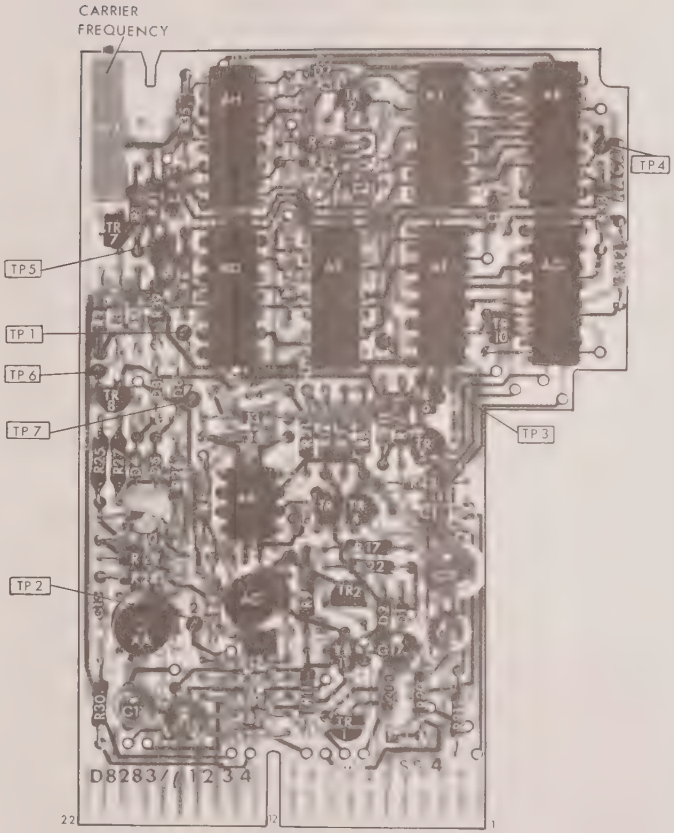

FIG.8 F.M. REPLAY BOARD - LAYOUT (DUAL STANDARD) D8283

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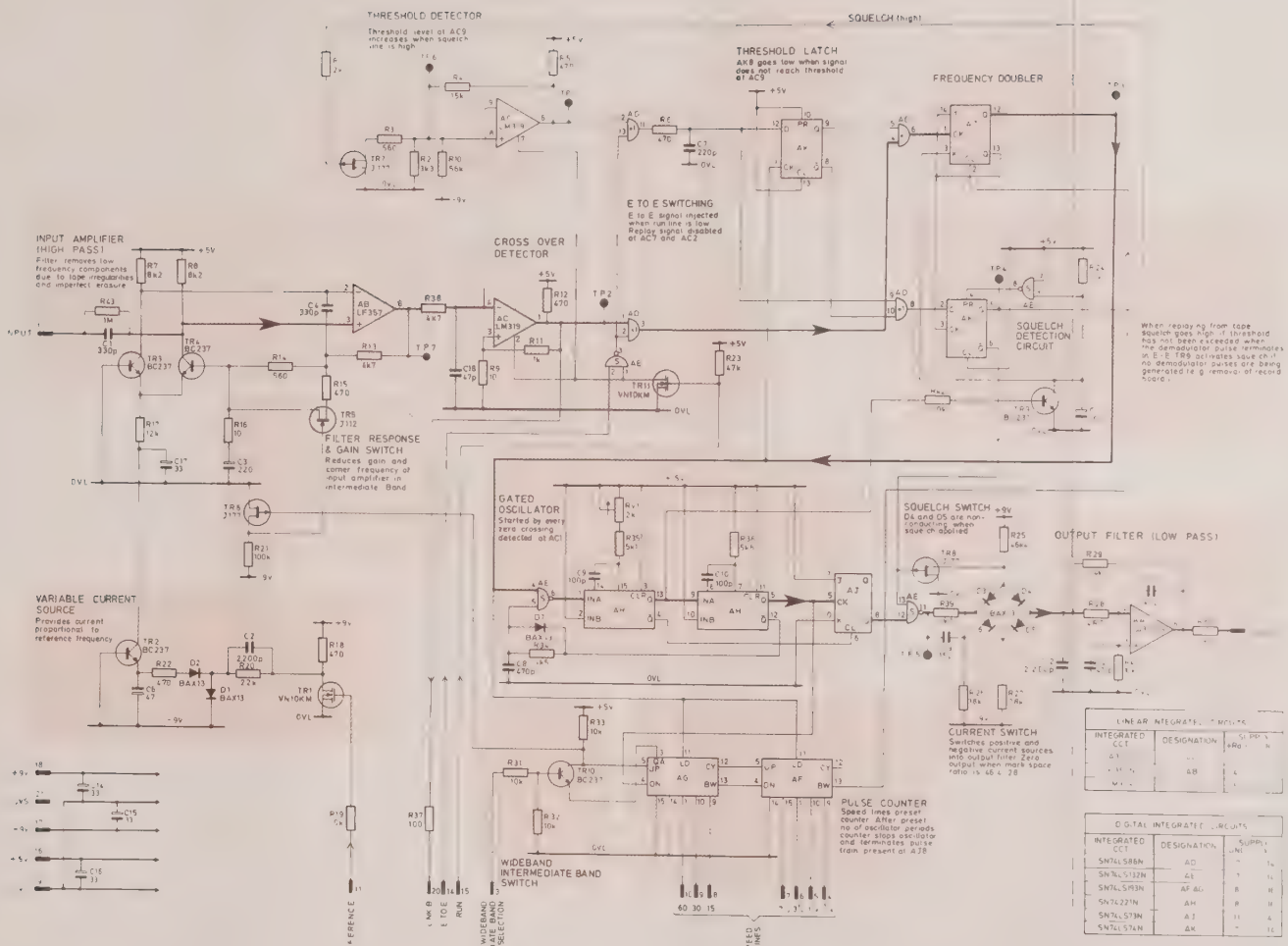
THRESHOLD DETECTOR
Threshold level at AC9 increases when squelch line is high
SQUELCH (high)
THRESHOLD LATCH
AX8 goes low when signal does not reach threshold at AC9
FREQUENCY DOUBLER
E TO E SWITCHING
E to E signal injected when run line is low. Replay signal disabled at AC7 and AC2
INPUT AMPLIFIER (HIGH PASS)
Filter removes low frequency components due to tape irregularities and imperfect erasure
CROSS OVER DETECTOR
SQUELCH DETECTION CIRCUIT
When replaying from tape squelch goes high if threshold has not been exceeded when the demodulator pulse terminates in B-B. TR9 activates squelch ckt. no demodulator pulses are being generated ie. g. removal of record, more.
FILTER RESPONSE & GAIN SWITCH
Reduces gain and corner frequency of input amplifier in intermediate Band
GATED OSCILLATOR
Started by every zero crossing detected at AC1
SQUELCH SWITCH
D4 and D5 are non-conducting when squelch applied
OUTPUT FILTER (LOW PASS)
VARIABLE CURRENT SOURCE
Provides current proportional to reference frequency
CURRENT SWITCH
Switches positive and negative current sources into output filter. Zero output when mark space ratio is 48 : 28
PULSE COUNTER
Speed lines preset counter. After preset no of oscillator periods counter stops oscillator and terminates pulse train present at A38
WIDEBAND INTERMEDIATE BAND SWITCH
REFERENCE
RUN
WIDEBAND INTERMEDIATE BAND SELECTION
SPEED LINES
LINEAR INTEGRATED CIRCUITS
DIGITAL INTEGRATED CIRCUITS

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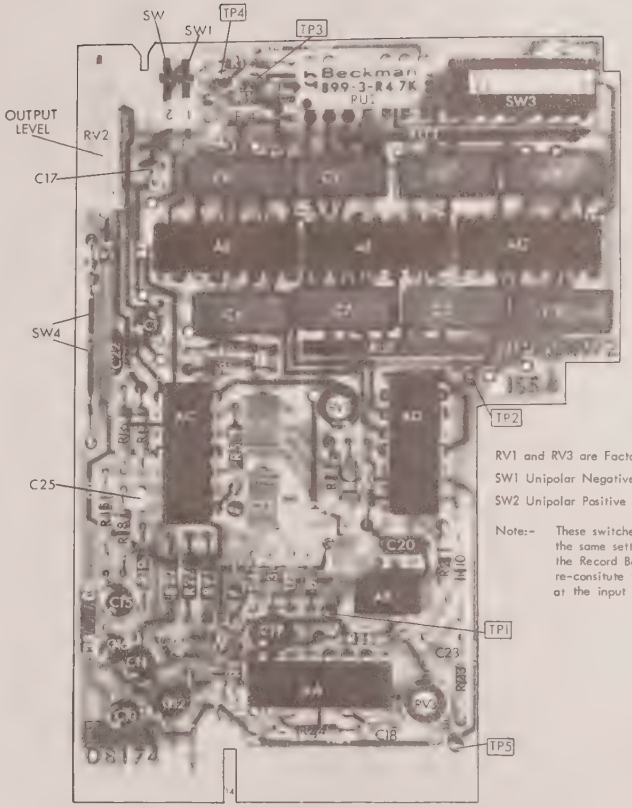
FIG. 9
F.M. REPLAY BOARD - CIRCUIT
(DUAL STANDARD)

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	F.M. FILTER BOARD (Dual Standard)			D8174
Capacitors				
C1,15,16	22 µF	20%	10 V	C162220
C2,3	1150 pF	1%	30 V	Cat 14649
C4,5	1611 pF	1%	30 V	Cat 15865
C6	290 pF	1%	30 V	Cat 15864
C7	308 pF	1%	30 V	Cat 14648
C8,9	3891 pF	1%	30 V	Cat 15866
C10,11,12	10 µF	20%	16 V	C163100
C13,14	.47 µF	5%	100 V	Cat 12729
C17	4.7 pF	± .25pF	63 V	Cat 13713
C18	.001 µF	10%	100 V	Cat 12033
C19	100 pF	1%	400 V	Cat 15367
C20	.1 µF	-20% +80%	100 V	Cat 12321
C21,23	47 µF	20%	10 V	C162470
C24	.022 µF	10%	100 V	Cat 13646
C25	390 pF	10%	100 V	Cat 13396
C26	220 pF	2%	63 V	Cat 10357
Cover Dust	Erg Switch Cover DS16A			Cat 13060
Diodes				
D1-D4	Mullard BAX 13			Cat 8406
Integrated Circuits				
AA	Texas 74LS221			Cat 14047
AB	Texas TL081CP			Cat 14374
AC	Texas TL074CN green spot			Cat 15384
AD	RCA CA3127E blue spot			Cat 14377
AE,AG	RCA CA3127E blue or yellow spot			Cat 14377
AF	Texas TLO74CN red spot			Cat 15385
Potentiometers				
RV1	1k Spectrol			Cat 15350
RV2	5k Spectrol			Cat 12402
RV3	10k Spectrol			Cat 15351

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	F.M. FILTER BOARD (Contd) (Dual Standard)			D8174
Resistors				
R1	220Ω	5%	¼W	R10221
R2	560Ω	5%	¼W	R10561
R3	150k	5%	¼W	R10154
R5	470Ω	2%	¼W	R30471
R6	3k3	2%	¼W	R30332
R7	1M	5%	¼W	R10105
R8	820k	5%	¼W	R10824
R9	6k19	1%	⅛W	R206191
R10,17,18	1k	5%	¼W	R10102
R11,12	102k	1%	⅛W	R201023
R13	11k3	1%	⅛W	R201132
R14,16	39k	5%	¼W	R10393
R15,21	10k	5%	¼W	R10103
R19	68..	5%	¼W	R10680
R20	Select on Test			
R22	100k	5%	¼W	R10104
R23	4k7	5%	¼W	R10472
R24	6k8	5%	¼W	R10682
R25	30k	5%	¼W	R10303
R26	1k8	5%	¼W	R10182
R27	3k48	1%	⅛W	R203481
R30	10k	2%	¼W	R30103
Resistor Arrays				
RU1	Bourns			Cat 15330
RU2	Beckman			Cat 15332
RU3				Cat 15331
Socket, Integrated Circuit				
4 off				Cat 12795
Switches				
S1,S2	DIL Erg			Cat 14210
S3	DIL Erg DS16A4-2			Cat 13104
S4	Reed, Hamlin, MSRR-220-30AT			Cat 11539
Terminal Assemblies				
TP1,5	Vero			Cat 13747



RV1 and RV3 are Factory Preset

SW1 Unipolar Negative

SW2 Unipolar Positive

Note:- These switches should be to the same setting as those on the Record Board. This will re-consitute the signal to that at the input to the equipment.

FIG.10 F.M. FILTER BOARD - LAYOUT (DUAL STANDARD) D8174

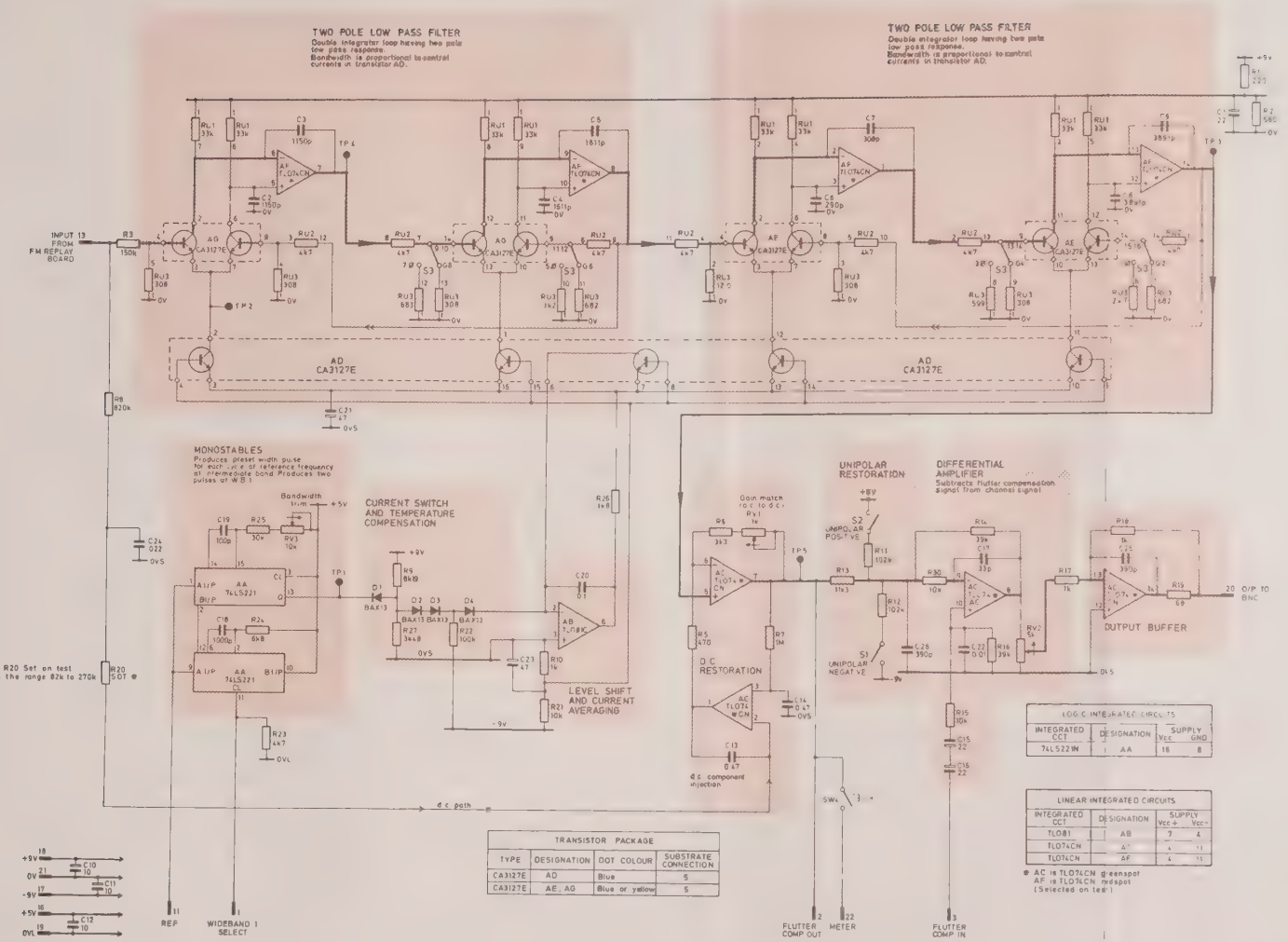

TWO POLE LOW PASS FILTER
Double integrator loop having two pole low pass response.
Bandwidth is proportional to control currents in transistor AD.
TWO POLE LOW PASS FILTER
Double integrator loop having two pole low pass response.
Bandwidth is proportional to control currents in transistor AD.
INPUT 13 FROM FM REPLAY BOARD
AD CA3127E
MONOSTABLES
Produces preset width pulse for each cycle of reference frequency at intermediate band. Produces two pulses at WB 1
CURRENT SWITCH AND TEMPERATURE COMPENSATION
LEVEL SHIFT AND CURRENT AVERAGING
UNIPOLAR RESTORATION
DIFFERENTIAL AMPLIFIER
Subtracts flutter compensation signal from channel signal
DC RESTORATION
OUTPUT BUFFER
20 O/P TO BNC
* R20 Set on test in the range 82k to 270k *
d.c component injection
d.c path
REF
WIDEBAND 1 SELECT
FLUTTER COMP OUT
METER
FLUTTER COMP IN
TRANSISTOR PACKAGE
TYPE | DESIGNATION | DOT COLOUR | SUBSTRATE CONNECTION
CA3127E | AD | Blue | 5
CA3127E | AE, AG | Blue or yellow | 5
LOGIC INTEGRATED CIRCUITS
INTEGRATED CCT | DESIGNATION | SUPPLY Vcc | SUPPLY GND
74LS221N | AA | 16 | 8
LINEAR INTEGRATED CIRCUITS
INTEGRATED CCT | DESIGNATION | SUPPLY Vcc+ | SUPPLY Vcc-
TL081 | AB | 7 | 4
TL074CN | AC | 4 | 11
TL074CN | AF | 4 | 11
* AC is TL074CN greenspot
AF is TL074CN redspot
(Selected on test)

FIG.11
F.M. FILTER BOARD - CIRCUIT
(DUAL STANDARD)

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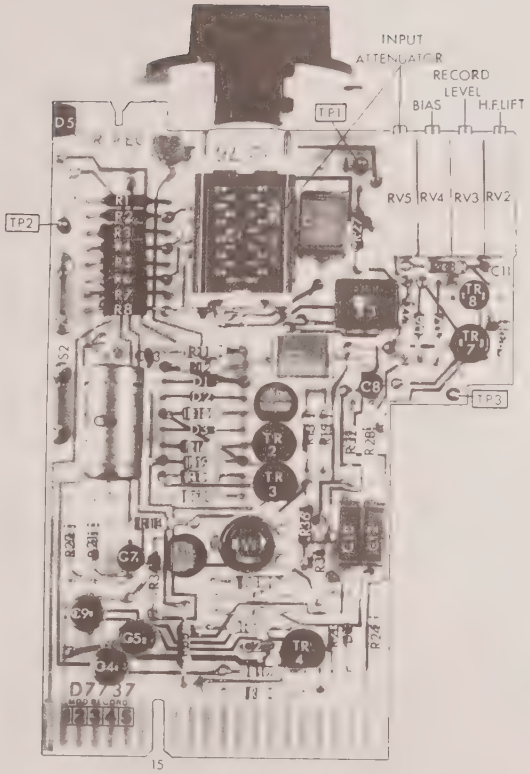
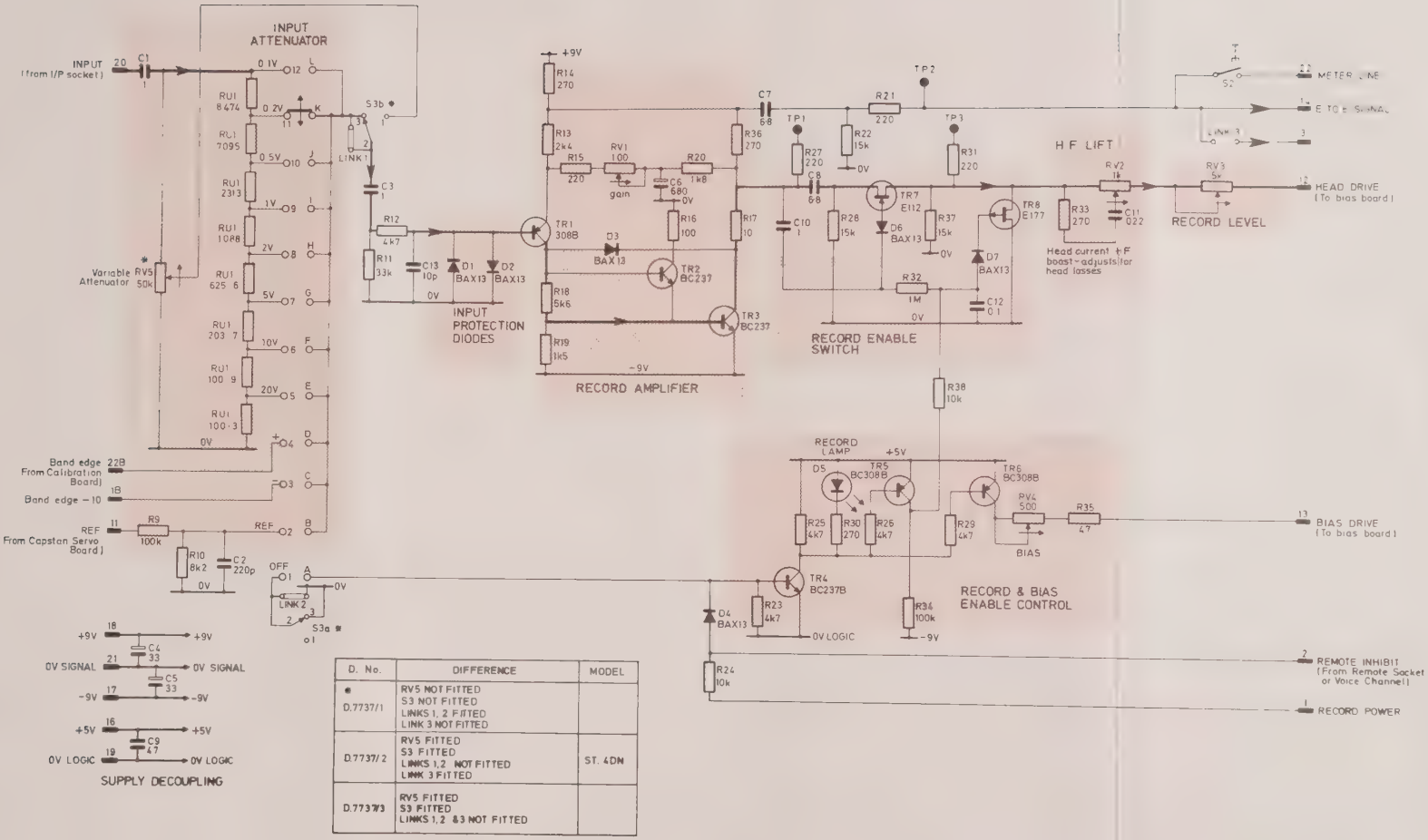
CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	D.R. RECORD			D7737
Capacitors				
C1, 3	1.0μF	5%	100V	Cat 13708
C2	220pF	2%	63V	Cat 10357
C4, 5	33μF	20%	16V	C 163330
C6	470μF	-10 +50%	6.3V	Cat 13655
C7, 8	6.8μF	20%	16V	Cat 14212
C10, 12	0.1μF	5%	250V	Cat 14252
C11	2200pF	10%	100V	Cat 13646
C13	10pF	2%	63V	Cat 12030
C9	47μF	20%	16V	Cat 13433
Diodes				
D1 - 4, 6, 7	BAX13			Cat 8406
D5	L.E.D. (light emitting diode)			Cat 15103
Potentiometers				
RV1	100Ω			Cat 12408
RV2, 4	1k			Cat 11930
RV3	5k			Cat 12402
RV5	50k			Cat 12420
Resistors				
R1 *	8474Ω	0.5%	¼W	Cat 12343
R2 *	7095Ω	0.5%	¼W	Cat 12344
R3 *	2313Ω	0.5%	⅛W	Cat 12345
R4 *	1088Ω	0.5%	1/16W	Cat 12346
R5 *	625.6Ω	0.5%	1/16W	Cat 12347
R6 *	203.7Ω	0.5%	1/16W	Cat 12348
R7 *	100.9Ω	0.5%	⅛W	Cat 12349
R8 *	100.3Ω	0.5%	1/16W	Cat 12354
R9, R34	100k	5%	¼W	R10104
R10	8k2	5%	¼W	R10822
R11	33k	5%	¼W	R10333
R12, 23, 25, 26, 29	4k7	5%	¼W	R10472
R13	2k4	5%	¼W	R10242
R14, 30, 33, 36	270Ω	5%	¼W	R10271
R15, 21, 27, 31	220Ω	5%	¼W	R10221
R16	100Ω	5%	¼W	R10101
R17	10Ω	5%	¼W	R10100
R18	5k6	5%	¼W	R10562
R19	1k5	5%	¼W	R10152

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	D.R. RECORD (Contd)			D7737
Resistors (Contd)				
R20	1k8	5%	¼W	R10182
R22, 28, 37	15k	5%	¼W	R10153
R24	10k	5%	¼W	R10103
R32	1M	5%	¼W	R10271
R35	47Ω	5%	¼W	R10470
*Resistor Array	R1 to R8 are replaced by RU1 on later boards.			
RU1				Cat 15336
Sockets				
2 off	Testprobe socket			Cat 2683
Switches				
S1	Switch			P15831
	Knob			D7601/3
S2	Switch, reed			Cat 11539
S3	Switch, slide, Siemens			Cat 14653
Terminal Assembly				
3 off	Vero 22436			Cat 13747
Transistors				
TR1, 5, 6	BC308			Cat 11977
TR2, 3, 4	BC237			Cat 11978
TR7	E112 F.E.T.			Cat 10540
TR8	E177			Cat 13967
	Switch 3 and RV5 Customer Option			



NOTE:- Switch 3 Positions.
Position 1, Left Position, Switched Attenuator
Position 2, Right Position, Variable Attenuator

FIG. 12 D.R. RECORD BOARD - LAYOUT D7737



D. No.	DIFFERENCE	MODEL
* D.7737/1	RV5 NOT FITTED S3 NOT FITTED LINKS 1, 2 FITTED LINK 3 NOT FITTED	
D.7737/2	RV5 FITTED S3 FITTED LINKS 1,2 NOT FITTED LINK 3 FITTED	ST. 4DN
D.7737/3	RV5 FITTED S3 FITTED LINKS 1, 2 &3 NOT FITTED	

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FIG. 13
D.R. RECORD BOARD - CIRCUIT

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	D.R. REPLAY 1			D7734
Capacitors				
C1, 3	33 µF	20%	16V	C16330
C2	0.1 µF	10%	35V	Cat 13782
C4, 10, 11	47 µF	20%	10V	Cat 13433
C5, 6 *	0.1 µF	10%	250V	Cat 14256
or				
C5, 6*	0.22 µF	5%	100V	Cat 13712
C7	220 pF	2%	63V	Cat 10357
C8, 9	330 pF	2%	63V	Cat 13714
C12, 13, 19, 20	592 pF	2½%	30V	Cat 14213
C14, 21	1850 pF	2½%	30V	Cat 14214
C15, 22	4350 pF	2½%	30V	Cat 14215
C16, 23	9350 pF	2½%	30V	Cat 14216
C17, 24	19350 pF	2½%	30V	Cat 14217
C18, 25	39400 pF	2½%	30V	Cat 14219
Integrated Circuits				
AA, AB	Signetics 8T 94A - Store 14DS			Cat 14303
Potentiometers				
RV1, RV2	5k			Cat 12402

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
Resistors				
R1	150k	5%	¼ W	R10154
R2	2k2	5%	¼ W	R10222
R3, 20	6k8	5%	¼ W	R10682
R4, 6, 11	1k5	5%	¼ W	R10152
R5, 7, 13, 21	220Ω	5%	¼ W	R10221
R8	1k2	5%	¼ W	R10122
R9, 10, 15, 35, 36, 37	10k	5%	¼ W	R10103
R12	680Ω	5%	¼ W	R10681
R14, 16, 19	1k	5%	¼ W	R10102
R17	33k	5%	¼ W	R10333
R18, 34	4k7	5%	¼ W	R10472
R22 - 33	2M2	5%	¼ W	R10225
R38, 39	47k	5%	¼ W	R10473
Terminal Assemblies				
TP1 - 3	Vero 22436			Cat 13747
Transistors				
TR1, 3, 6	BC308B			Cat 11977
TR2, 4, 5, 8, 10	BC237B			Cat 11978
TR7, 9	E177			Cat 13967

* 0.22 µF fitted for 50 Hz L.F. response.

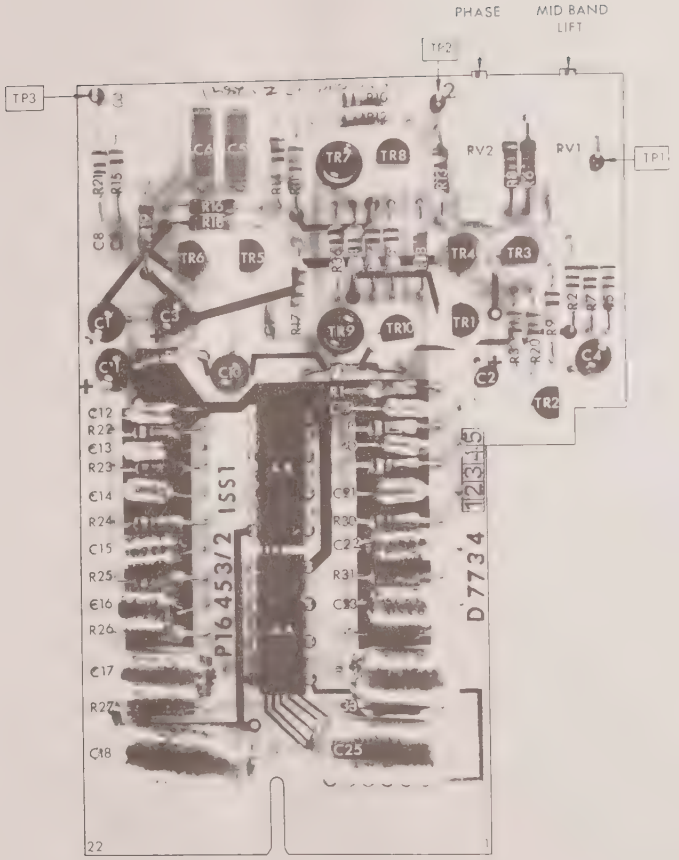
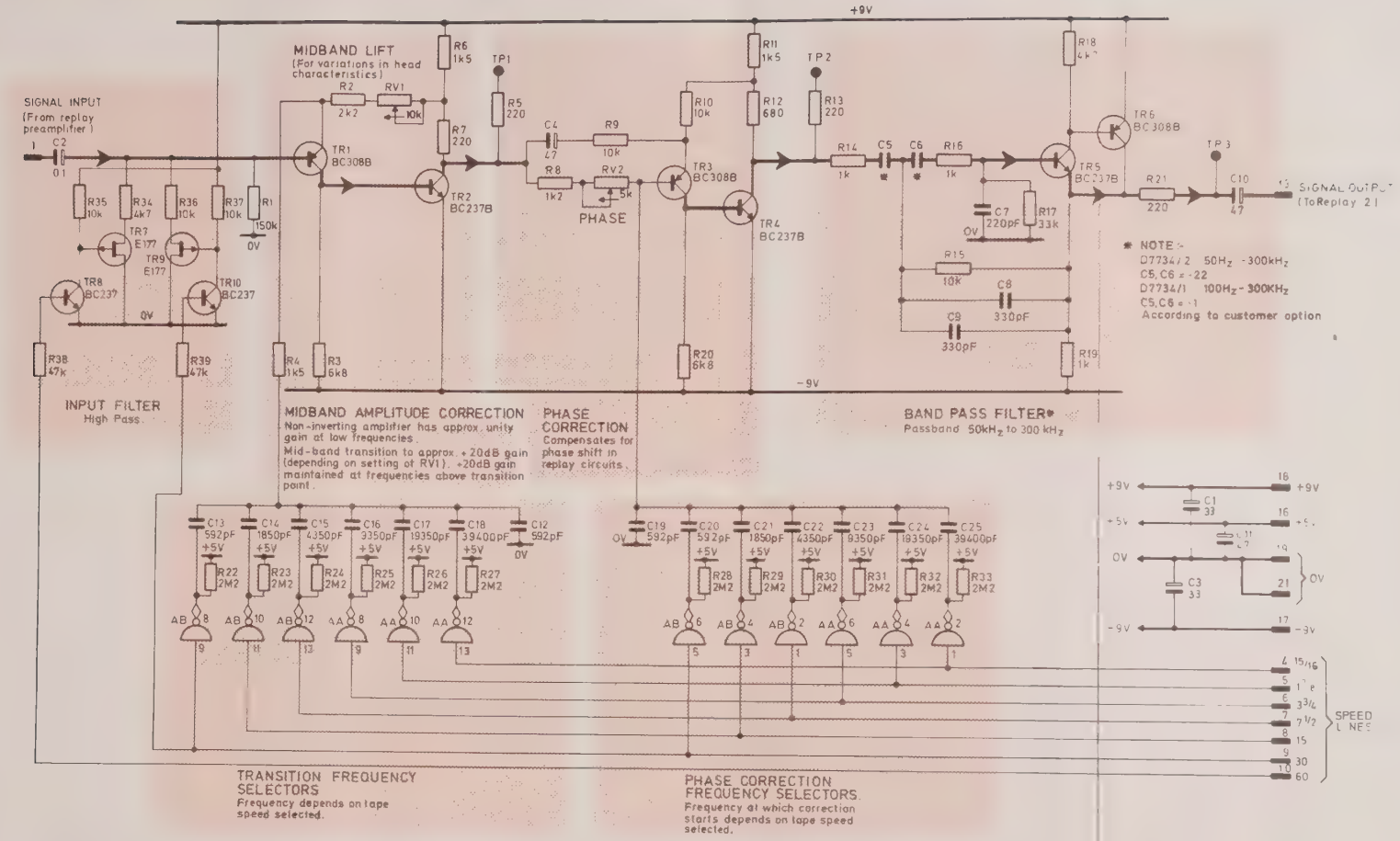


FIG. 14 D.R. REPLAY 1 BOARD - LAYOUT D7734/3



REF No	DIFFERENCE	USED ON
D7734/1	C5,C6 = 0·1μF AA,AB = SN7416N	STORE 4DS/7DS
D7734/2	C5,C6, = 0·22μF AA,AB = SN7416N	STORE 4DN STORE 4DS/7DS (OPTION)
D7734/3	C5,C6 = 0·1μF AA AB = 8T94A	STORE 14DS

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FIG.15
D.R. REPLAY 1 BOARD - CIRCUIT

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	D.R. REPLAY 2			D7689
Capacitors				
C1	592pF	2½%	30V	Cat 14213
C2,6	1850pF	2½%	30V	Cat 14214
C3,7	9350pF	2½%	30V	Cat 14216
C4,8	39400pF	2½%	30V	Cat 14219
C5	470pF	2½%	30V	Cat 14632
C9,12,15	47µF	20%	10V	Cat 13433
C10	47pF	2%	63V	Cat 11615
C13,14	33µF	20%	16V	C163330
Diodes				
D1-D3	BAX13			Cat 8406
Integrated Circuits				
AA,AB	SN7416N			Cat 12098
AC	LM318H			Cat 9982
Potentiometers				
RV1,3	10k Spectrol 43p			Cat 11931
RV2	20k			Cat 14327
Resistors				
R1,5	12Ω	5%	⅓W	Cat 14168
R2,3,4,6,7,8	2M2	5%	¼W	Cat 9725
R9,27,34	2k2	5%	¼W	Cat 8903
R10	4k7	5%	¼W	Cat 8886
R11,12,21,25	6k8	5%	¼W	Cat 8989
R13,32	5k6	5%	¼W	Cat 8898
R14,28	220Ω	5%	¼W	Cat 8889
R15,16,20,24,26	1k	5%	⅓W	Cat 8888
R17	1k2	5%	¼W	Cat 8909
R18	18k	5%	¼W	Cat 8897
R19	820Ω	5%	¼W	Cat 8917
R22	680Ω	5%	¼W	Cat 8892
R23	3k3	5%	¼W	Cat 8981
R33	68Ω	5%	¼W	Cat 9972
R36	10Ω	5%	⅓W	Cat 8899
R37	100k	5%	¼W	Cat 8884
Switch				
S1	Switch - reed			Cat 11539
Terminal Assembly				
4 off	Vero 22436			Cat 13747
Transistors				
TR1,TR8	J177			Cat 13967
TR2,5,6	BC237B			Cat 11978
TR3,4,7,10	BC308B			Cat 11977
TR9	E112			Cat 10540

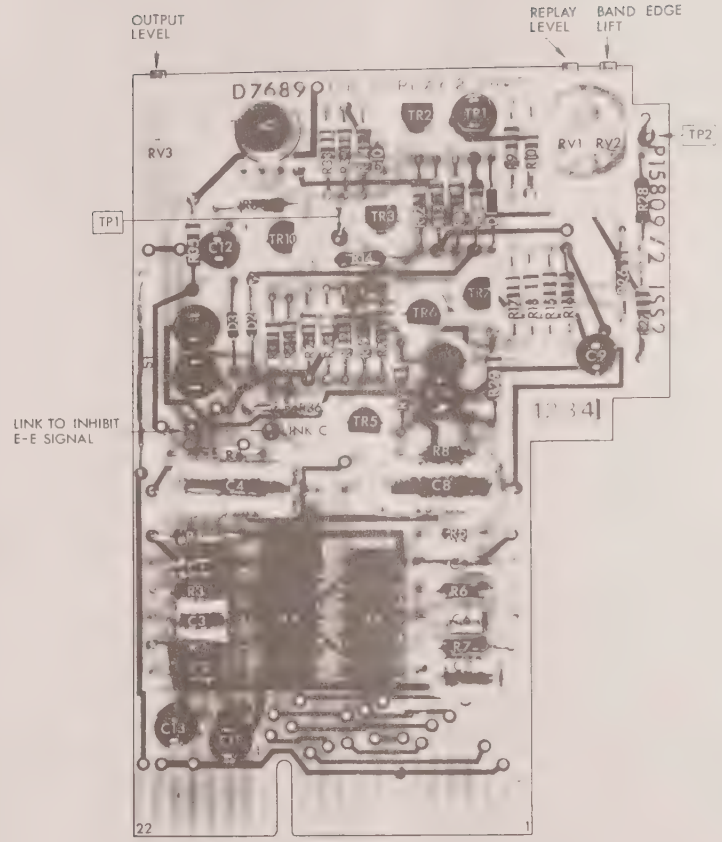
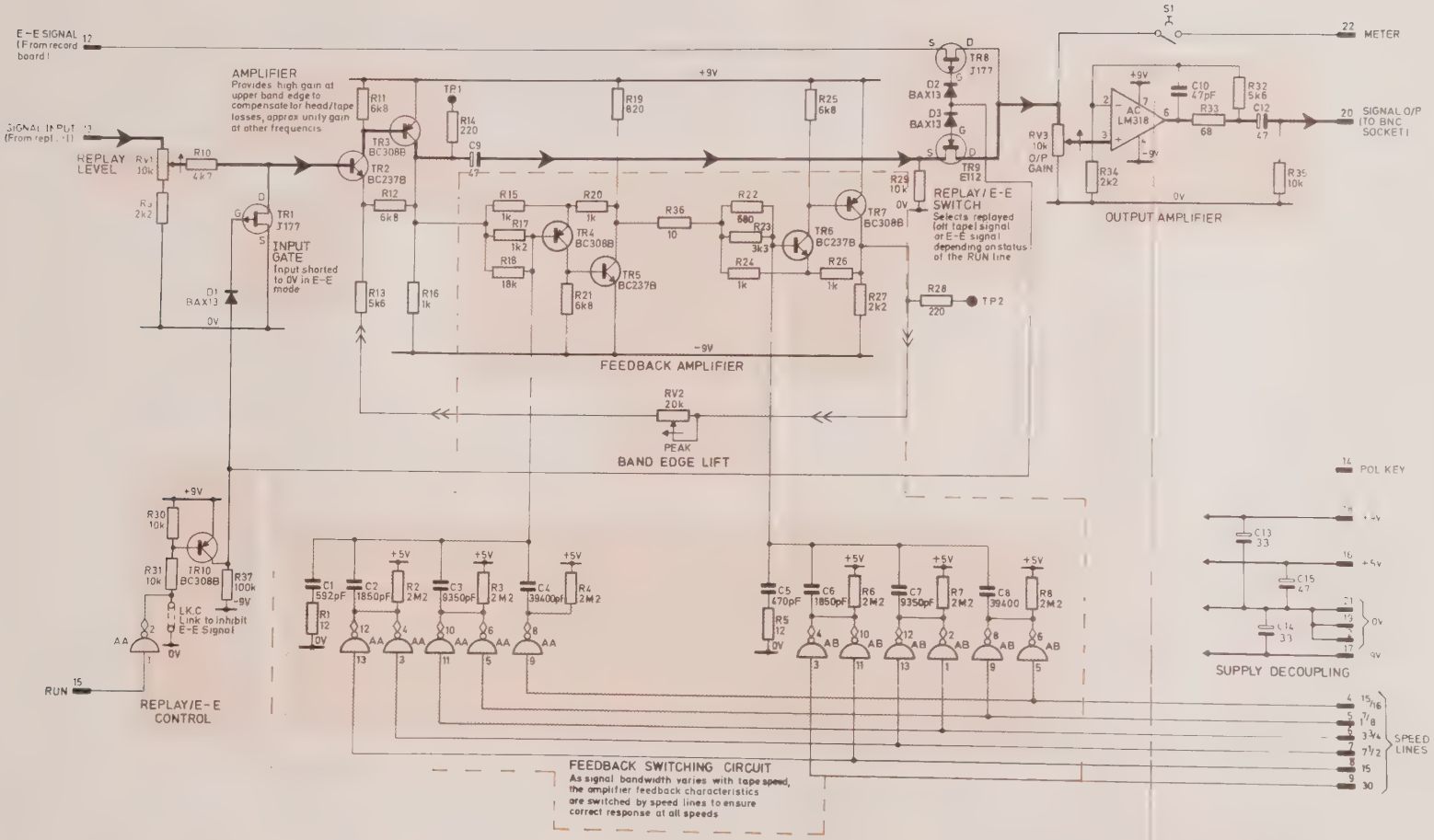


FIG. 16 D.R. REPLAY 2 BOARD - LAYOUT D7689

Store 14DS
Sept. 1982


E-E SIGNAL (From record board)
AMPLIFIER
Provides high gain at upper band edge to compensate for head/tape losses, approx unity gain at other frequencis
SIGNAL INPUT (From repl.)
REPLAY LEVEL
INPUT GATE
Input shorted to 0V in E-E mode
FEEDBACK AMPLIFIER
REPLAY/E-E SWITCH
Selects replayed tape signal or E-E signal depending on status of the RUN line
OUTPUT AMPLIFIER
METER
SIGNAL O/P (TO BNC SOCKET)
BAND EDGE LIFT
PEAK
POL KEY
SUPPLY DECOUPLING
REPLAY/E-E CONTROL
RUN
LK C Link to inhibit E-E Signal
FEEDBACK SWITCHING CIRCUIT
As signal bandwidth varies with tape speed, the amplifier feedback characteristics are switched by speed lines to ensure correct response at all speeds
SPEED LINES

Store 14 DS
March 1981

FIG. 17
D.R. REPLAY 2 BOARD - CIRCUIT

CIRCUIT REF	VALUE	TOL	RATING	MFRS REF NO
	VOICE CHANNEL BOARD			D8923
Capacitors				
C1	10 µF	20%	16V	C163100
C2,9,10,11	47 µF	20%	16V	C163470
C3	0.01 µF	+80% -20%	63V	28738-188-09
C4	2.3 µF	20%	16V	C163229
C5	4700 pF	+80% -20%	63V	28738-184-09
C6	22 µF	20%	16V	C163220
C7	0.015 µF	5%	160V	Cat 4169
C8	0.1 µF	10%	100V	Cat 13431
C12	220 pF	+80% -20%	63V	28338-129-02
Diodes				
D1,2	BAX 13			Cat 8406
Knob				
1 off	Moulded white spot			D7602 2
Heatsink				
1 off	Redpoint			Cat 14012
Integrated Circuit				
AA	RC4558			Cat 14373
AB	CD4053			5644053
AC	TDA2030H			Cat 14972
Potentiometer				
RV1	50k			Cat
RV2	1k			Cat 11930

CIRCUIT REF	VALUE	TOL	RAT NG	MFRS REF NO
Resistors				
R1,11	47	5%	¼ W	R10470
R2	1.2	5%	¼ W	R10122
R3,4,7	100	5%	¼ W	R10104
R5,6,15	2.2	5%	¼ W	R10222
R8	1k5	5%	¼ W	R10152
R9	6.8	5%	¼ W	R10682
R10	820	5%	¼ W	R10820
R12	4k7	5%	¼ W	R10472
R13,19	10k	5%	¼ W	R10103
R14,16	47k	5%	¼ W	R10473
R17	33k	5%	¼ W	R10333
R18	22	5%	¼ W	R10223
R20	3.9	5%	¼ W	R10392
R21	100	5%	¼ W	R10101
R22	4R7	5%	¼ W	R10479
R23	22	5%	¼ W	R10220
Switch				
S1	Siemens (42315-A68-A1)			Cat 14653
Transistors				
TR1	BC237B			Cat 11978
TR2	BC308B			Cat 11977

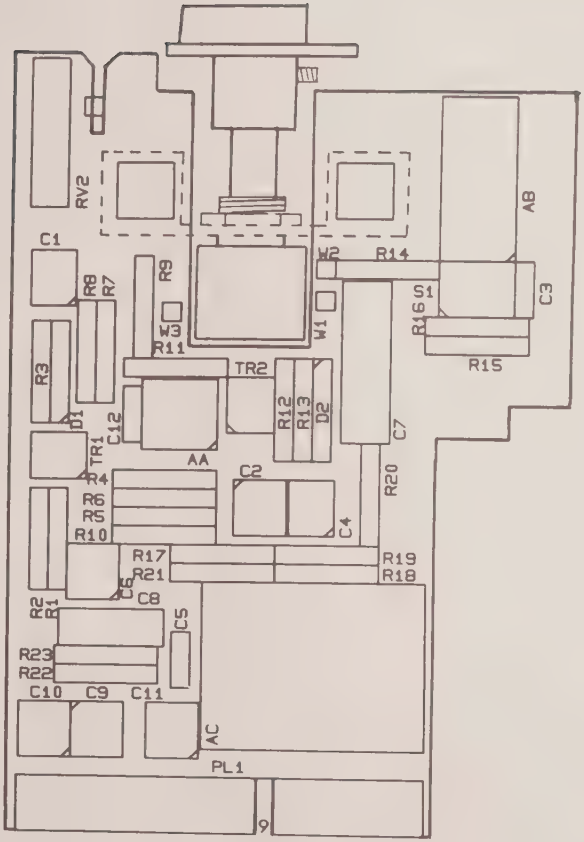
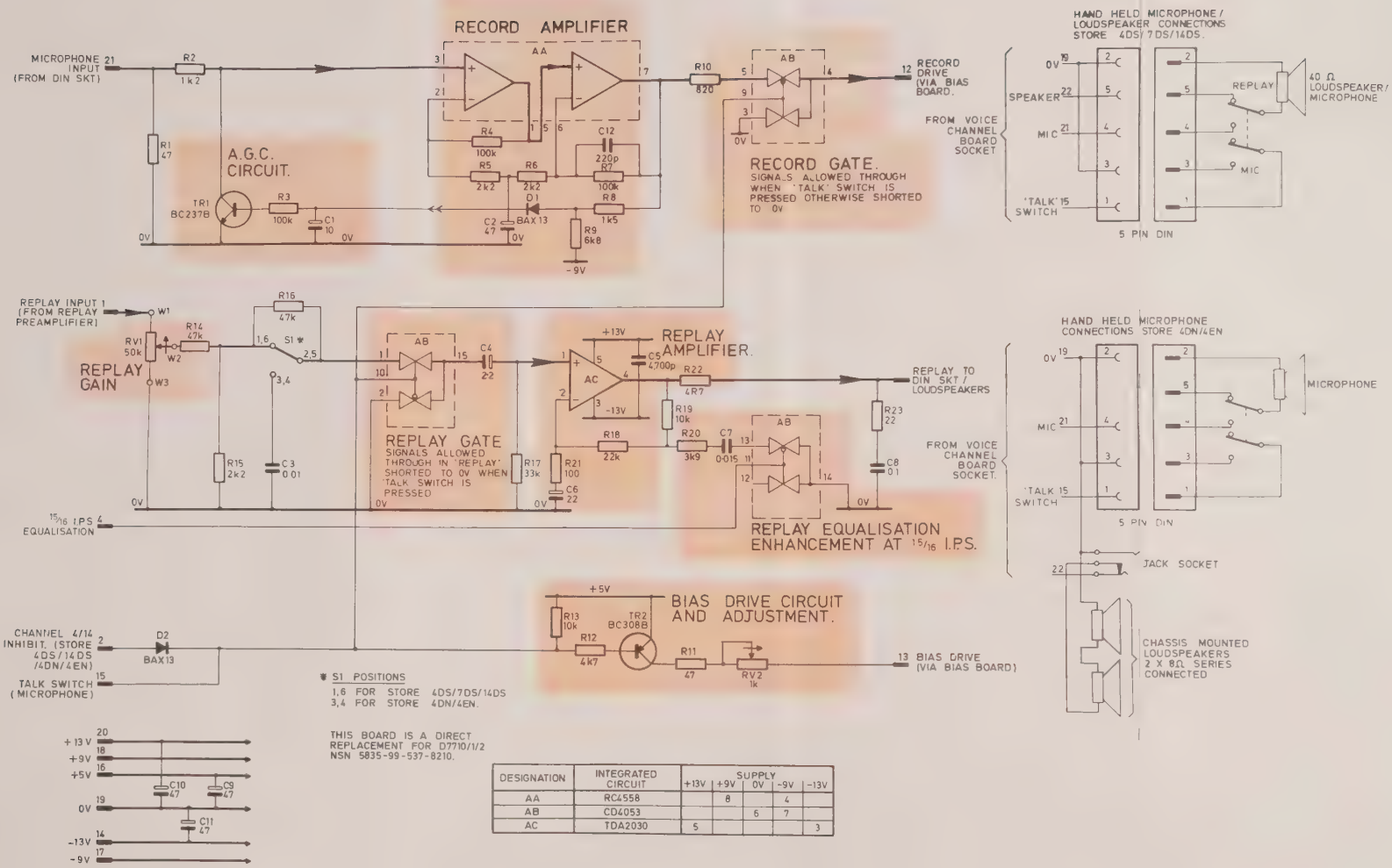


FIG.18 VOICE CHANNEL BOARD - LAYOUT D8923


RECORD AMPLIFIER
MICROPHONE INPUT (FROM DIN SKT)
A.G.C. CIRCUIT.
RECORD GATE.
SIGNALS ALLOWED THROUGH WHEN 'TALK' SWITCH IS PRESSED OTHERWISE SHORTED TO 0V
RECORD DRIVE (VIA BIAS BOARD.
FROM VOICE CHANNEL BOARD SOCKET
HAND HELD MICROPHONE / LOUDSPEAKER CONNECTIONS STORE 4DS/7DS/14DS.
SPEAKER
MIC
'TALK' SWITCH
REPLAY
40 Ω LOUDSPEAKER/ MICROPHONE
5 PIN DIN
REPLAY INPUT 1 (FROM REPLAY PREAMPLIFIER)
REPLAY GAIN
REPLAY GATE
SIGNALS ALLOWED THROUGH 'REPLAY' SHORTED TO 0V WHEN 'TALK SWITCH IS PRESSED
REPLAY AMPLIFIER.
REPLAY TO DIN SKT / LOUDSPEAKERS
REPLAY EQUALISATION ENHANCEMENT AT 15/16 I.P.S.
15/16 I.P.S EQUALISATION
HAND HELD MICROPHONE CONNECTIONS STORE 4DN/4EN
MICROPHONE
JACK SOCKET
CHASSIS MOUNTED LOUDSPEAKERS 2 X 8Ω SERIES CONNECTED
BIAS DRIVE CIRCUIT AND ADJUSTMENT.
13 BIAS DRIVE (VIA BIAS BOARD)
CHANNEL 4/14 INHIBIT. (STORE 4DS/14DS /4DN/4EN)
TALK SWITCH (MICROPHONE)
* S1 POSITIONS
1,6 FOR STORE 4DS/7DS/14DS
3,4 FOR STORE 4DN/4EN.
THIS BOARD IS A DIRECT REPLACEMENT FOR D7710/1/2
NSN 5835-99-537-8210.

DESIGNATION	INTEGRATED CIRCUIT	SUPPLY				
		+13V	+9V	0V	-9V	-13V
AA	RC4558		8		4	
AB	CD4053			6	7	
AC	TDA2030	5				3

FIG. 19
VOICE CHANNEL BOARD - CIRCUIT

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	REPLAY PREAMPLIFIER			D8303
	STORE 14DS			
Capacitors				
1C1-7C1	330µF	20%	3V	C160331
1C3-7C3	.0047µF	10%	100V	Cat 13647
1C4-7C4	220µF	20%	3V	C160221
1C5-7C5	100µF	20%	10V	C162101
1C6-7C6	220pF	2%	63V	Cat 10357
C7,8	33µF	20%	16V	C163330
C9,10	47µF	20%	10V	C162470
Resistors				
1R1-7R1	12k	5%	¼W	R10123
1R2-7R2	22Ω	5%	¼W	R10220
1R3-7R3	10k	1%	⅛W	R201002
1R4-7R4	1M2	5%	¼W	R10125
1R7-7R5	270Ω	5%	¼W	R10271
1R6-7R6, 1R9-7R9	2k2	5%	¼W	R10222
1R7-7R7, 1R8-7R8	1k5	5%	¼W	R10152
1R10-7R10	1k8	5%	¼W	R10182
1R11-7R11	100Ω	5%	¼W	R10101
Sockets				
SKT7	14 pin	D.I.L.		Cat 12782
SKT15	9 Way			Cat 15121
	7 Way			Cat 15122
Terminal Assembly	3 off	Vero		Cat 13747
Transistors				
1TR1-7TR1	2N4403			Cat 13970
1TR2-7TR2	ZTX384C			Cat 13630
1TR3-7TR3	ZTX213BK			Cat 13972
1TR4-7TR4	ZTX238BK			Cat 13973
Voltage Regulator				
AA	LM309H	(+5 Volts)		Cat 13223
AB	LM320H	(-5 Volts)		Cat 12649

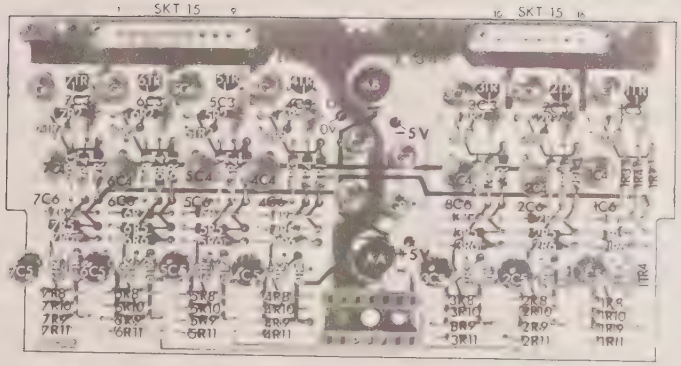
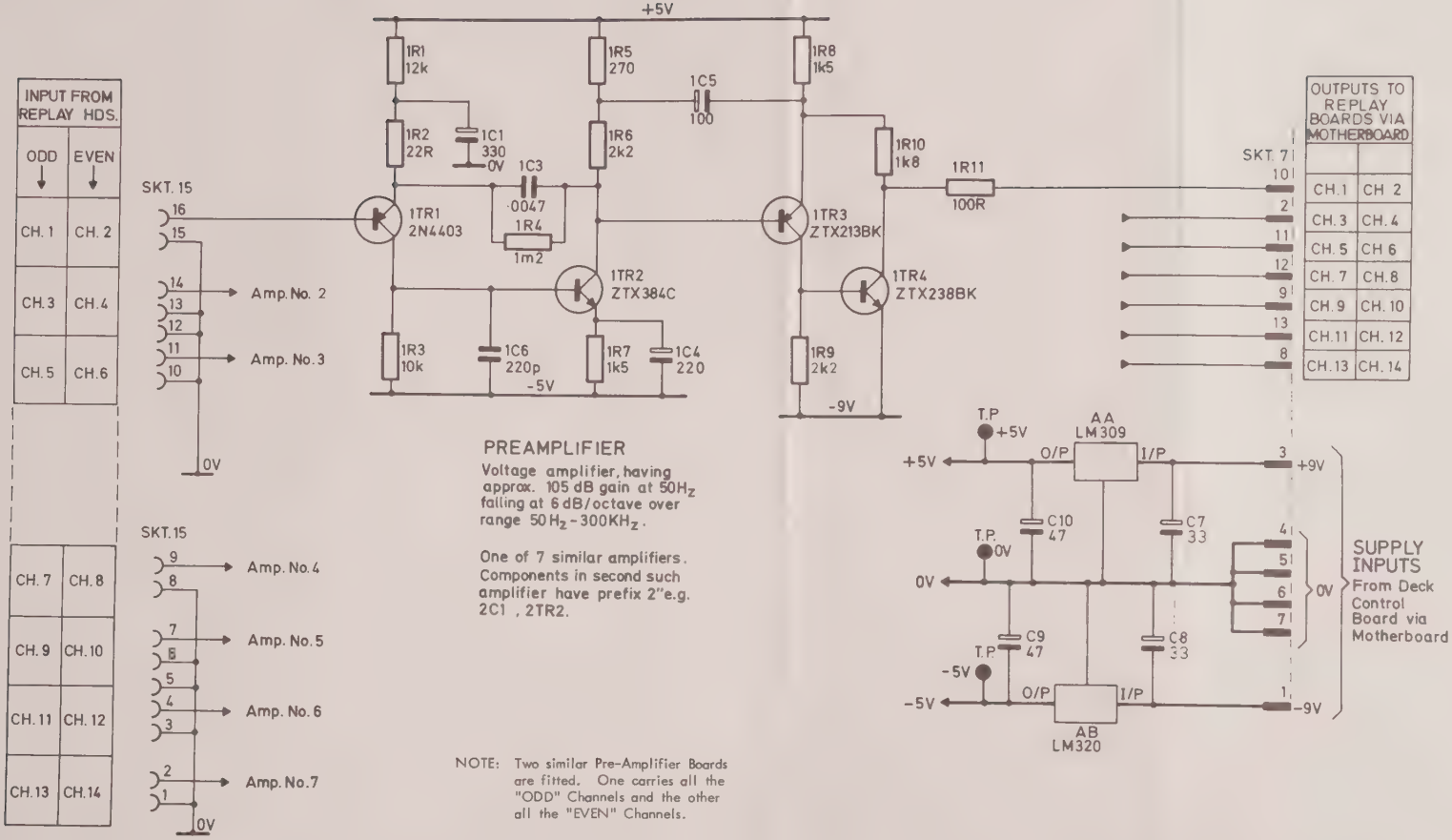


FIG. 20 REPLAY PREAMPLIFIER BOARD - LAYOUT D8303



PREAMPLIFIER

Voltage amplifier, having approx. 105 dB gain at 50Hz falling at 6 dB/octave over range 50Hz - 300KHz.

One of 7 similar amplifiers. Components in second such amplifier have prefix 2" e.g. 2C1, 2TR2.

NOTE: Two similar Pre-Amplifier Boards are fitted. One carries all the "ODD" Channels and the other all the "EVEN" Channels.

FIG. 21
REPLAY PREAMPLIFIER BOARD - CIRCUIT

Store 14DS
Sept. 1982

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	BIAS OSCILLATOR Odd Channels			D8301
Capacitors				
1C1 - 7C1	100pF		63V	Cat 10476
1C3 - 7C3				
1C2 - 7C2	150pF		63V	Cat 13645
1C4 - 7C4	10pF		63V	Cat 12030
1C5 - 7C5	10µF		10V	Cat 13435
C6, C7	33µF		16V	C163330
Chokes				
1L1 - 7L1				Cat 426
Diodes				
1D1 - 7D1	BAX13			Cat 8406
Holders				
38 off	Holders Components			Cat 14111
Integrated Circuits				
AA	SN74LS74N			Cat 15073
AB	SN7437N			Cat 13526
Resistors				
1R1-7R1 R6, R7, R8	1k	5%	¼W	R10102
1R2-7R2 1R4-7R4	100Ω	5%	¼W	R10101
1R3-7R3	330Ω	5%	¼W	R10331
1R5-7R5	10Ω	5%	¼W	R10100
Sockets				
SKT17, SKT18	14 pin D.I.L.			Cat 12782
SKT63	Connector Contact Strip 15 way			Cat 15120
	Guide Pins			Cat 11652
Link Socket	Female Fixed			Cat 14763
Terminal Assemblies				
9 off	Vero TP22436			Cat 13747
Transformers				
1T1-1T7				Cat 13839
Transistors				
1TR1-7TR1 1TR2-7TR2	2N3906			Cat 13625

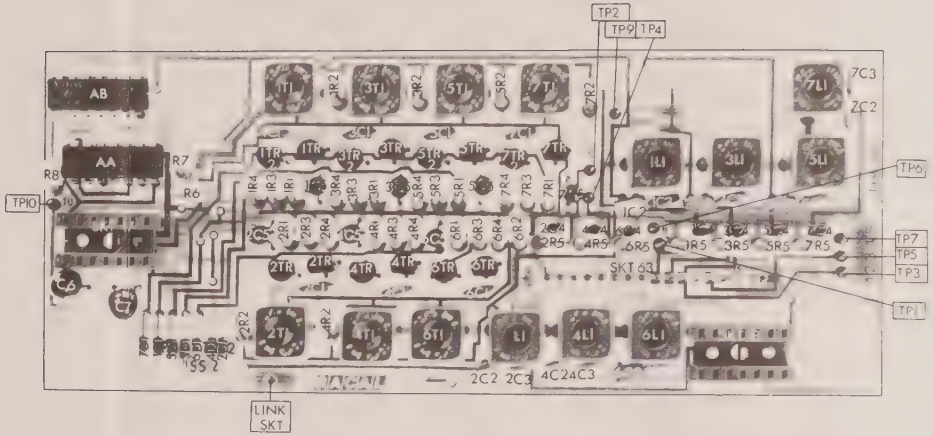
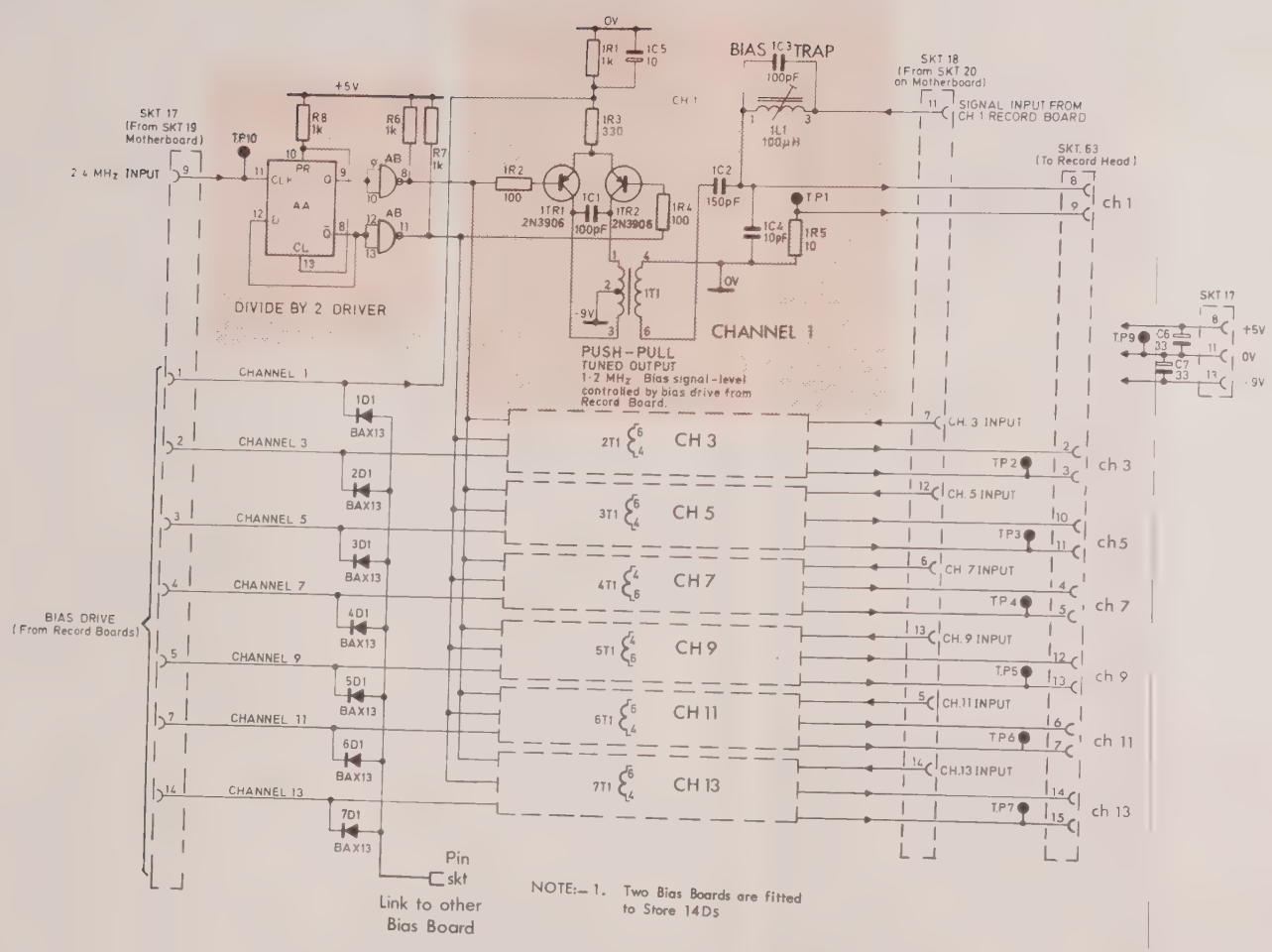


FIG. 22 BIAS OSCILLATOR BOARD - LAYOUT (Odd Channels) D8301



NOTE:— 1. Two Bias Boards are fitted to Store 14Ds

2. The "ODD", Channels are carried on this board and are identified with the pre-fix 1 - 7

Store 14DS
March 1981

FIG. 23

BIAS OSCILLATOR BOARD - CIRCUIT
(Odd Channels)

CIRCUIT REF	VALUE	TOL	RATING	MFRS REF NO.
	BIAS OSCILLATOR Even Channels			D8307
Capacitors				
1C1 - 7C1 }	100pF		63V	Cat 10476
1C3 - 7C3 }				
1C2 - 7C2	150pF		63V	Cat 13645
1C4 - 7C4	10pF		10V	Cat 12030
1C5 - 7C5	10µF		10V	Cat 13435
Co. ' '	33µF		16V	C163330
Chokes				
1L1 - 7L1				Cat 426
Diodes				
1D1 - 7D1, D2	BAX 13			Cat 8406
Holders				
40 off	Holders, Components			Cat 14111
Integrated Circuit				
AA	SN74LS74N			Cat 15073
AB	SN7437N			Cat 13526
Resistors				
1R1-7R1, R6, R7, R8 }	1k	5%	¼W	R10102
1R2-7R2 }	100Ω	5%	¼W	R10101
1R4-7R4 }				
1R3-7R3	330Ω	5%	¼W	R10331
1R5-7R5	10Ω	5%	¼W	R10100
R9	3k9	5%	¼W	R10392
R10	47k	5%	¼W	R10473
R11	22k	5%	¼W	R10223
Sockets				
SKT17, SKT18	14 pin D.I.L.			Cat 12782
SKT63	Connector Contact Strip			Cat 15120
Link SKT	Female fixed			Cat 14763
Terminal Assemblies				
9 off	Vero TP22436			Cat 13747
Transformers				
1T1 -7T1				Cat 13839
Transistors				
1TR1 -7TR1	2N3906			Cat 13625
1TR2 -7TR2				Cat 11978
TR3	BC237B			

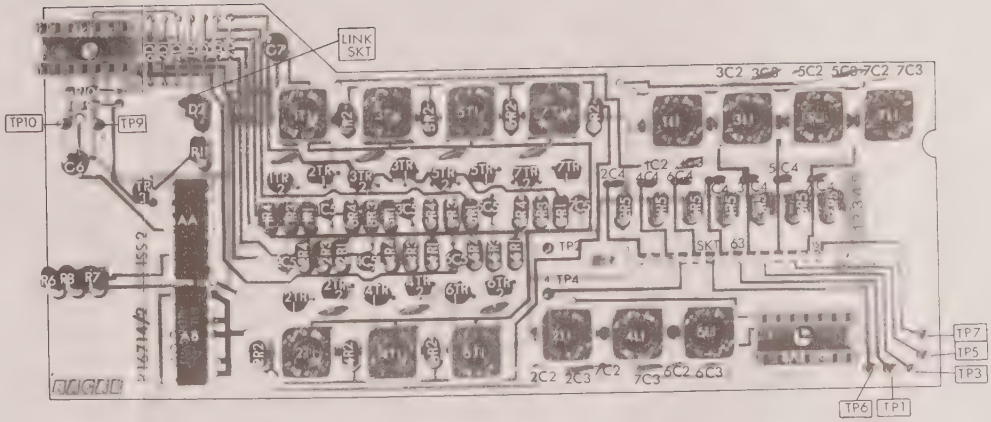
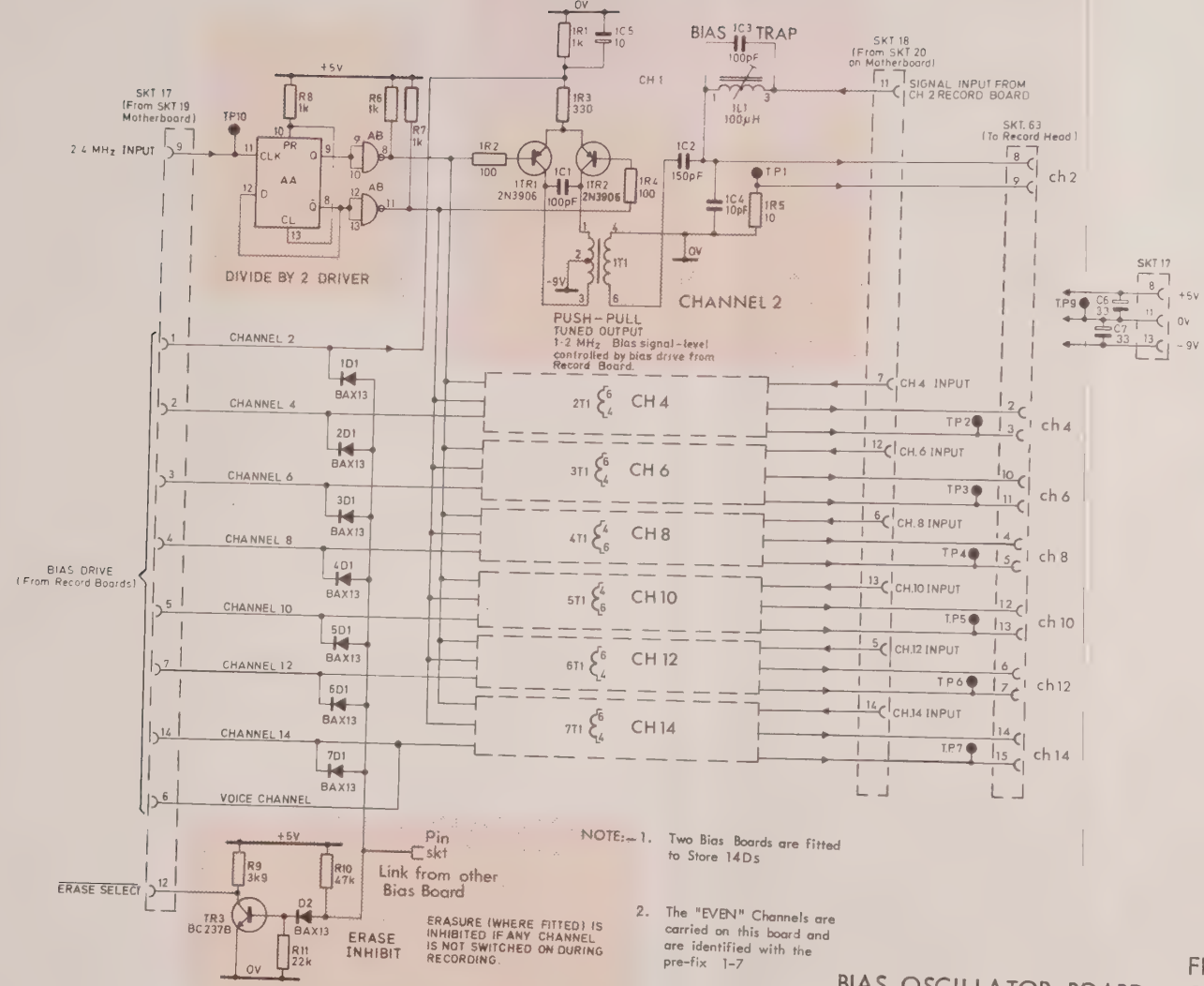


FIG.24 BIAS OSCILLATOR BOARD - LAYOUT
(Even Channels)
D8302



NOTE:- 1. Two Bias Boards are fitted to Store 14Ds

2. The "EVEN" Channels are carried on this board and are identified with the pre-fix 1-7

FIG. 25

BIAS OSCILLATOR BOARD - CIRCUIT
(Even Channels)

Store 14DS
March 1981

CIRCUIT REF	VALUE	TOL	RATING	MFRS. REF. NO.
	METER ASSEMBLY			D7679
1 off	Meter			P14281
S1	Switch, 2 pole c/o Plessey 82121			Cat 12122
1 off	Meter Amplifier Assembly			D7676
	METER AMPLIFIER ASSEMBLY			D7676
Capacitors				
C1,2	33µF	20%	16V	C 163330
C3	100pF	2%	63V	Cat 10476
C4,5	0.1µF	5%	100V	Cat 13719
Diodes				
D1 - 4	Mullard BAX 13			Cat 8406
Integrated Circuits				
AA	National LM310H			Cat 11401
AB	Transistor array - CA3046			Cat 9650
Potentiometers				
RV1,3	2k2 Bourns VA05H			Cat 13844
RV2,4	1k Bourns VA05V			Cat 11938

CIRCUIT REF	VALUE	TOL	RATING	MFRS. REF. NO.
	METER AMPLIFIER ASSEMBLY (Contd)			D7676
Resistors				
R1,8	10k	5%	¼ W	R10103
R2 (4D/7D)	1M	5%	¼ W	R10105
R2 (4DN)	3M3	5%	¼ W	R10335
R3,4	10..	5%	¼ W	R10100
R5,11,19, 21,25	1k	5%	¼ W	R10102
R6,16,18	4k7	5%	¼ W	R10472
R9	510..	5%	¼ W	R10511
R10	270..	5%	¼ W	R10271
R12,22	10M	5%	¼ W	R10106
R13,23	6k8	5%	¼ W	R10682
R14,24	1k8	5%	¼ W	R10182
R17	47k	5%	¼ W	R10473
R20	2k2	5%	¼ W	R10222
Socket				
SKT57	Contacts, Molex 2759, 4 off Socket Housing Molex			Cat 14191 Cat 12794
Transistors				
TR1,3,4,6	Telefunken BC3088			Cat 11977
TR2,5	Siliconix E112			Cat 10540
Terminal Assembly				
TP1,2,3	Vero 22436			Cat 13747

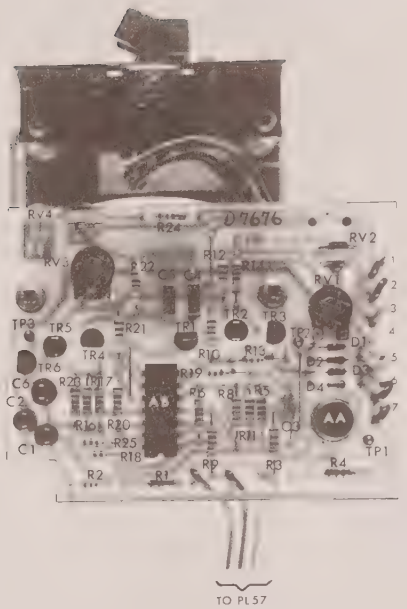
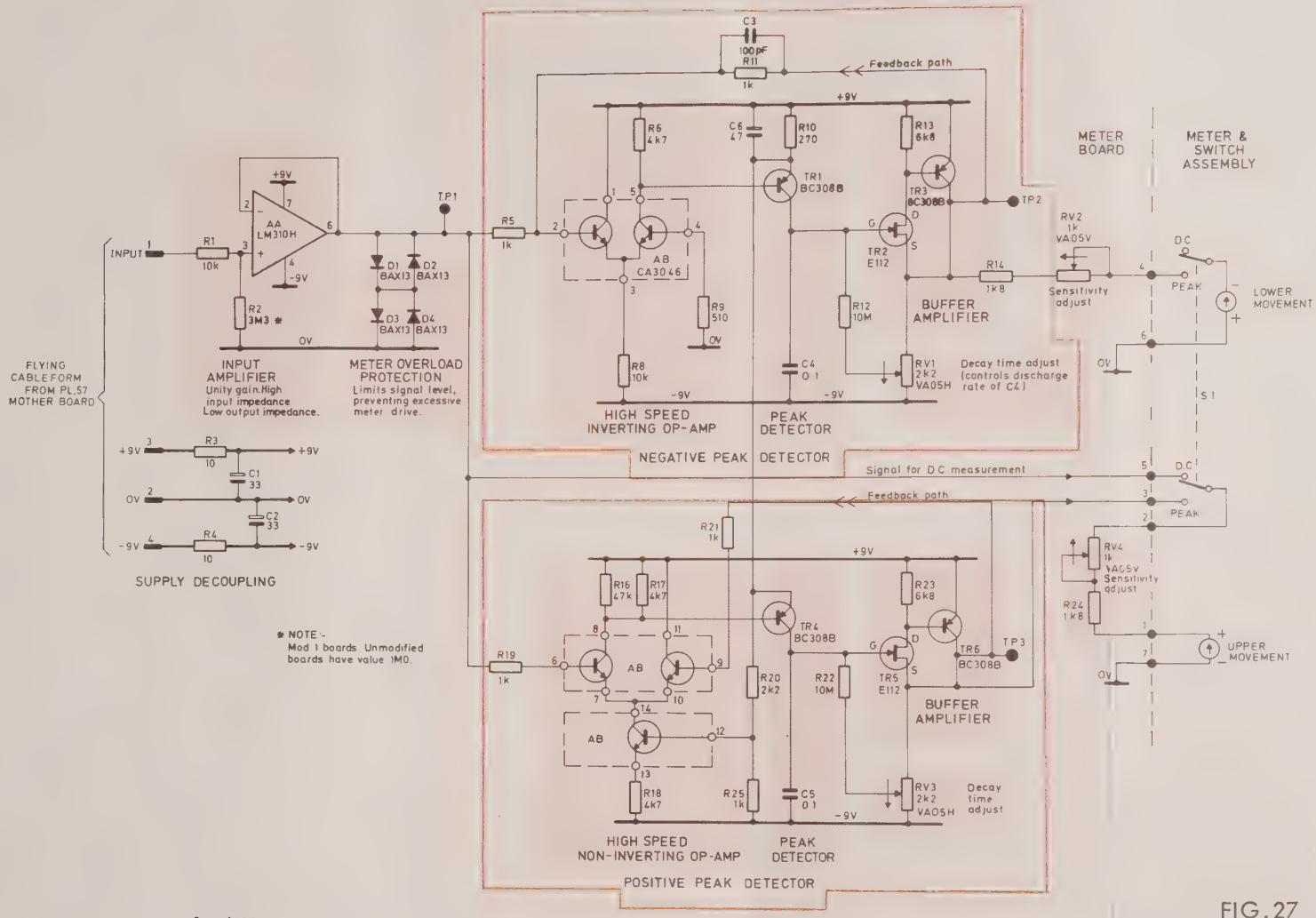


FIG.26 METER ASSEMBLY D7679



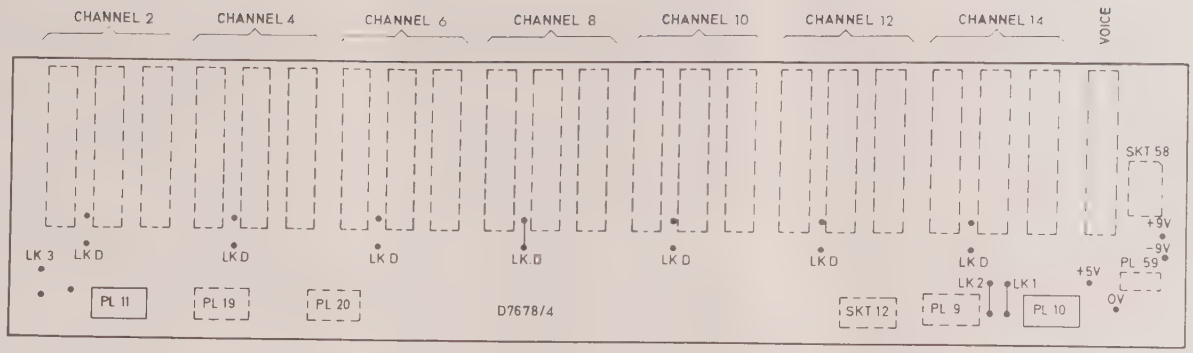
Store 14DS
March 1981

FIG. 27
METER ASSEMBLY - CIRCUIT

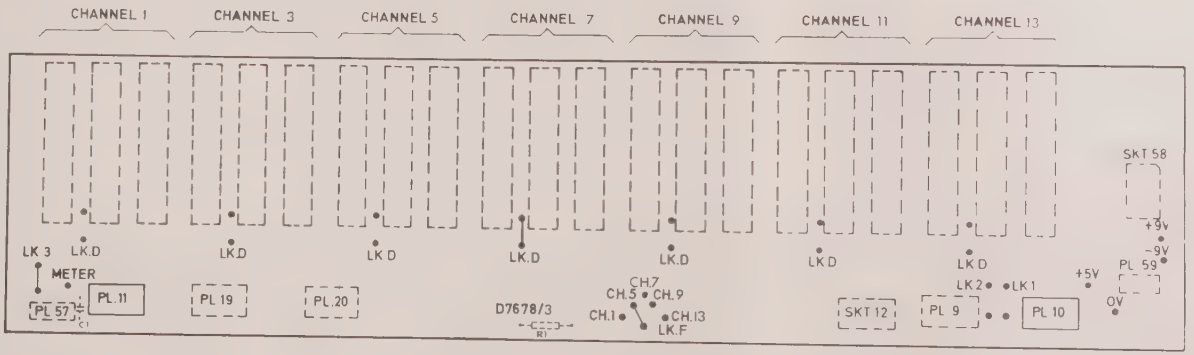
CIRCUIT REF.	VALUE	TOL	RATING	MFRS REF. NO.
	MOTHERBOARD ASSEMBLY			
	Odd Channels			D7678/3
	Even Channels			D7678/4
Cableform Connectors	(one per Mother Board)			
PL9	To Odd Replay Preamplifier			D8331/1
	To Even Replay Preamplifier			D8331/2
PL19	To Odd Bias Board (Power)			D8332/1
	To Even Bias Board (Power)			D8332/2
PL20	To Odd Bias Board (Record Signals)			D8333/1
	To Even Bias Board (Record Signals)			D8333/2
Cableform Connectors	(Common Connections to both Motherboards)			
PL10	To Deck Control			D8334
PL11	To Capstan Servo			D8335
PL12	To Remote Socket			D8328
Capacitor				
C1	1000 pF	10%	100 V	Cat 12033
Connectors				
43 off	Connectors, Edge 23 & 2 way			Cat 14586
86 off	Key, Connector Polarising			Cat 10028
Plugs				
PL59	2 off			Cat 14181
PL57	1 off	Odd Board only		Cat 14181
Resistor				
R1	820	5%	W	Cat 12308
Sockets				
SKT12,SKT58	14 pin D.I.L.			Cat 12782
Terminals				
110 off	Pin, Terminal			Cat 15082

NOTES:-

1. Link D selects the reference channel for flutter compensation. This is normally channels 7 and 8 on Store 14Ds.
2. Link F selects the reference channel for TAPE mode replay speed control. This is normally channel 5.
3. Links 1,2,3, are shown correct for Store 14Ds.



EVEN CHANNELS

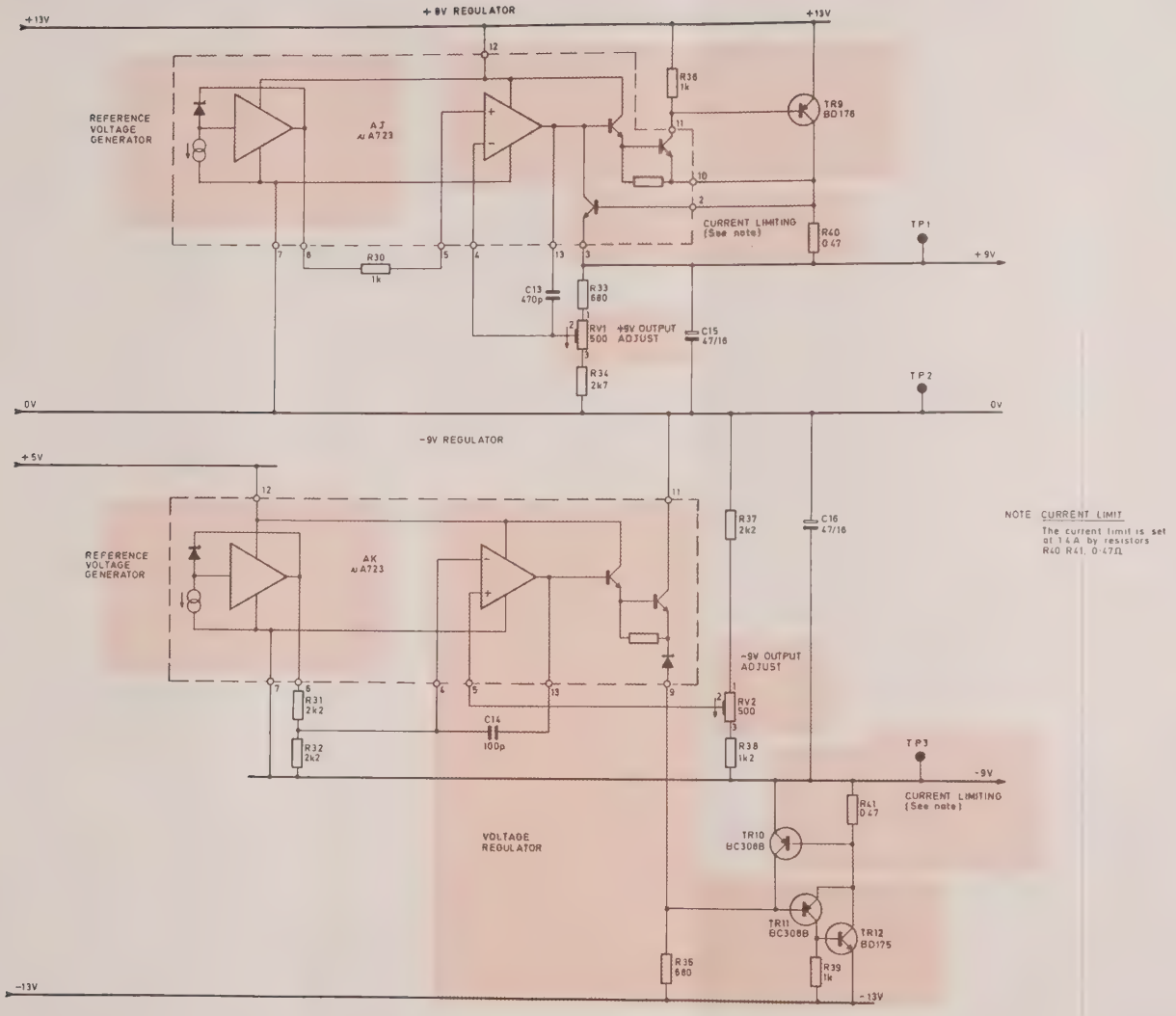


ODD CHANNELS

VIEW OF UNDERSIDE OF MOTHERBOARDS as seen when the equipment is standing on its rear casting, with the base cover removed.

FIG. 28 MOTHERBOARDS - LAYOUT D7678/3 and D7678/4

Store 14DS
November 1979



NOTE CURRENT LIMIT

The current limit is set at 1·4A by resistors R40 R41, 0·47Ω

FIG. 29
9 VOLT REGULATORS - CIRCUIT
(Part of Deck Control Board)
(See Fig. 30 for Layout)

Store 14DS
Sept. 1982

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	DECK CONTROL BOARD (including 9V Regulators)			D8901
Capacitors				
C1,6,15,16	47µF	20%	10 V	C162470
C2,3	0.1µF	10%	100 V	Cat 13431
C4,5	100µF	20%	25 V	Cat 14431
C7,8,9,10, 11,12	0.47µF	20%	35 V	C166478
C13	470pF	10%	100 V	28738-159-00
C14	100pF	2%	63 V	28738-125-02
Diodes				
D1	BAX13			Cat 8406
DZ1	BZY88	C4V7		Cat 10122
Integrated Circuits				
AA	SN74LS00N			Cat 15077
AB,AC	SN74LS20N			Cat 16914
AD	SN74LS10N			Cat 15818
AE	SN74LS08N			Cat 15071
AF	SN74LS02N			Cat 15070
AG,AH	SN7416N			Cat 12098
AJ,AK	µA723			Cat 12099
Plugs				
PL78	14 way Molex			Cat 14951
PL79	3 way Molex			Cat 14498
Potentiometers				
RV1,2	500Ω Spectrol 43p			Cat 12409
Relay				
RLA	ITT, RS12			Cat 11841
Resistors				
R1	6k8	5%	¼ W	R10682
R2	10k	5%	¼ W	R10103
R3,24,25,26, 27,28,29	100	5%	¼ W	R10101
R4,6,11	4k7	5%	¼ W	R10472
R5,10,19,20, 21,22,23,30, 36,39	1k	5%	¼ W	R10102

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	DECK CONTROL BOARD (Contd) (including 9V Regulator)			D8901
R7	470 or 680 (To suit d.c. erase head)	5% 5%	¼ W ¼ W	R10471 R10681
R8,34,35	680	5%	¼ W	R10681
R9	560	5%	¼ W	R10561
R12,14,15, 16,17,18,31, 32,37	2k2	5%	¼ W	R10222
R13,34	2k7	5%	¼ W	R10272
[illegible]	1k2	5%	¼ W	R10122
R40	0.42Ω	10%	2½ W	Cat 11501
Sockets				
SK1,2,3,80	14 pin DIL			Cat 12782
Switches				
S1	Switch SDS2			Cat 15669
S2	Switch SDC1			Cat 15666
Terminals				
5 off	Terminal Assembly			Cat 13746
TS1	Terminal Faston			Cat 2678
Transistors				
TR1,13	ZTX 450			Cat 13628
TR2	ZTX 550			Cat 13629
TR3,4,5,6, 7,8	BC237 B			Cat 11978
TR9	BD176			Cat 12381
TR10,11	BC308B			Cat 11977
TR12	BD175			Cat 11980
	Transistor Heatsink			P14865
8 off	Transistor Mounting Pad			Cat 1179
3 off	Transistor Mounting Pad			Cat 11543

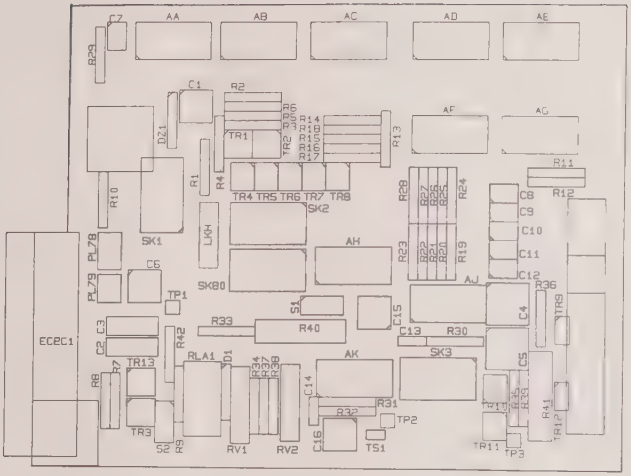
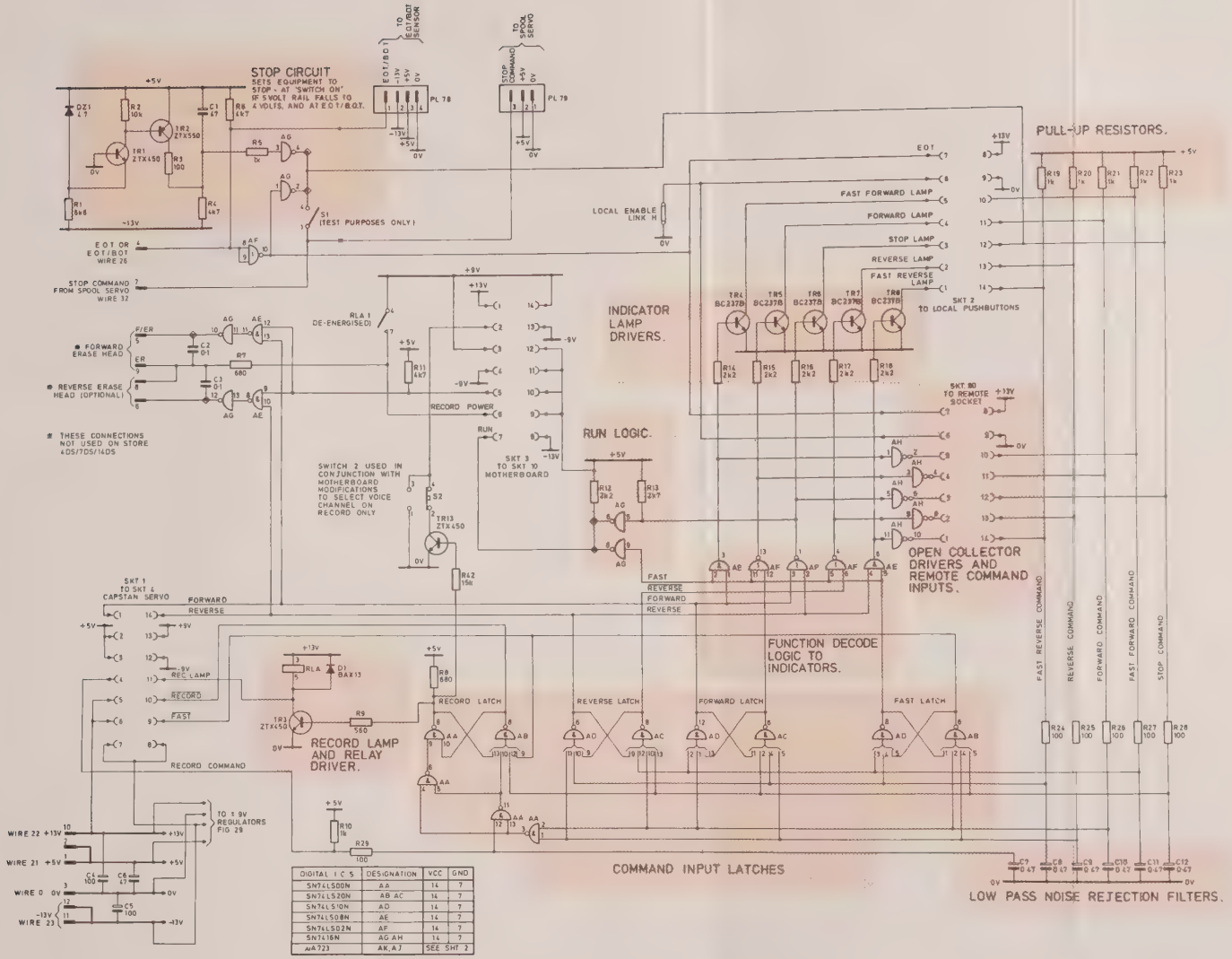


FIG. 30 DECK CONTROL BOARD - LAYOUT (Including 9 Volt Regulators) D8901



DIGITAL I C S	DESIGNATION	VCC	GND
SN74LS00N	AA	14	7
SN74LS20N	AB AC	14	7
SN74LS10N	AD	14	7
SN74LS08N	AE	14	7
SN74LS02N	AF	14	7
SN7416N	AG AH	14	7
uA723	AK, AJ	SEE SHT 2	

FIG.31
DECK CONTROL BOARD - CIRCUIT
(See Fig.29 for 9V Regulators)

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	SPOOL SERVO P.C. BOARD			D6522
Capacitors				
C1	10μF	20%	10V	C162100
C2, 3, 6, 9, 11	1μF	10%	160V	Cat 13423
C4, 5	2.2μF	20%	35V	C166229
C8, 10	1000pF	10%	100V	Cat 12033
C12, 13, 18	47μF	20%	16V	C163470
C14, 15	0.1μF	10%	100V	Cat 13431
C16	33μF	20%	16V	C163330
C17	47μF	20%	10V	C162470
Chokes				
L1, 2	100μH	Plessey (ITT ref 58/10/0017/10)		Cat 11679
Diodes				
D1-5	Mullard BAX13			Cat 8406
D6-9	Telefunken BZ102 C1V4 or 2 off Mullard BAX 13			Cat 12648 Cat 8406
Diode Zener				
DZ1	Mullard BZY88 C5V6			Cat 2851
Integrated Circuits				
AA, AB, AC, AD, AE, AF, AG	Signetics μA741 (8 pin D.I.P.)			Cat 9796
Relay				
RLA	Thorn Bendix RS12			Cat 11841
Resistors				
R1	15Ω	5%	¼W	R10150
R2	220Ω	5%	¼W	R10221
R3, 4, 7	47k	2%	¼W	Cat 12633
R5	100k	2%	¼W	Cat 12379
R6	56k	2%	¼W	Cat 12634
R8, 31	15k	5%	¼W	R10153
R9, 10, 25, 26	47k	5%	¼W	R10473
R11	150Ω	5%	¼W	R10151
R12	270Ω	5%	¼W	R10271
R13, 14, 28, 29, 36, 38, 39, 42, 51, 54	10k	5%	¼W	R10103
R15, 22	2k2	5%	¼W	R10222
R16, 43, 55	100k	5%	¼W	R10104
R17	560Ω	5%	¼W	R10561
R18, 33	6k8	5%	¼W	R10682
R19	27k	5%	¼W	R10273
R20, 24, 27	12k	5%	¼W	R10123
R21, 23, 37, 44, 45, 48, 52, 56, 57, 60	4k7	5%	¼W	Cat 10472

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	SPOOL SERVO P.C. BOARD (Contd)			D6522
Resistors (Cont)				
R30	3k9	5%	¼W	R10392
R32	2k7	5%	¼W	R10272
R41, 53	1k5	5%	¼W	R10152
R46, 47, 58, 59	330Ω	5%	¼W	R10331
R49, 61	3.3Ω	5%	¼W	R10339
R50, R62	0.1Ω	5%	3W	Cat 12623
R63, 64	1k	5%	¼W	R10102
Socket				
SKT32	Cinch 133-51-92-005			Cat 12782
Transistors				
TR1	Telefunken BD175			Cat 11980
TR2, 6, 11	Telefunken BC237B			Cat 11978
TR3, 4, 12	Telefunken BC308B			Cat 11977
TR5, 10	Siliconix E112			Cat 10540
TR8, TR13	RCA TA8204			Cat 13640
TR9, 14	RCA TA8202			Cat 13639
Heatsink				P14864
Spacer, (Captive)				P14868
Terminal	AMP 61134-1 110 Series			Cat 2678
Transistor Pads				
7 off	Milton Ross 10171			Cat 1179
2 off	Jermyn TO-18-002			Cat 11541
Turret Lugs	Harwin H2121			Cat 1067
Washer (nylon)				P14885
	SPOOL SERVO BOARD			D6935
	This board is similar to D6522 (see above) with the following exceptions:-			
Capacitors				
C3	omitted			
Resistors				
R18, 24, 27, 39, 51	4k7	5%	¼W	R10472
R19	47k	5%	¼W	R10473
R21	12k	5%	¼W	R10123
R22	omitted			
R23	replaced by wire link			
R30	1k	5%	¼W	R10102
R31	10k	5%	¼W	R10103
R33	5k6	5%	¼W	R10562

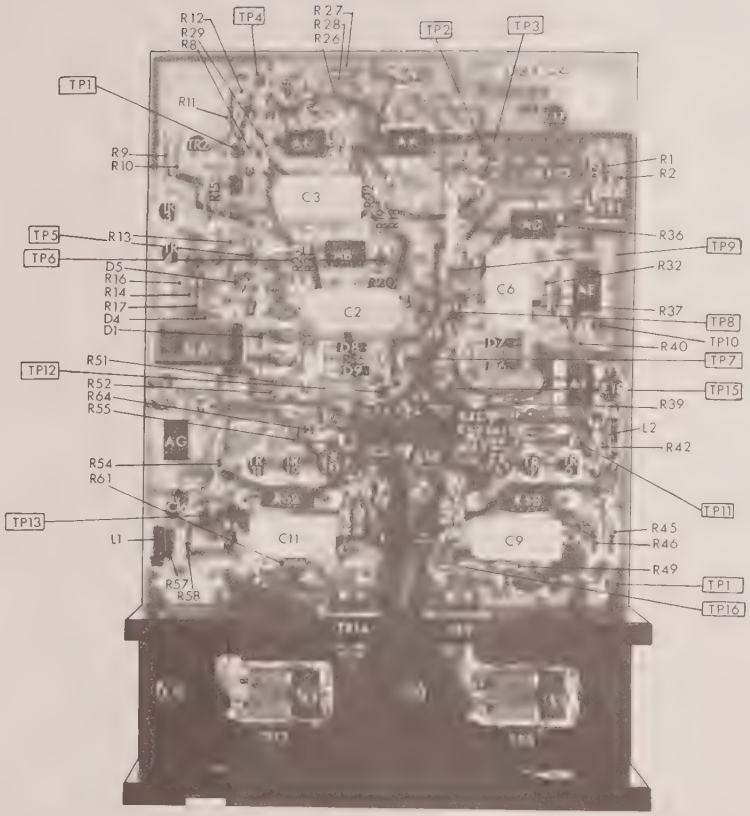
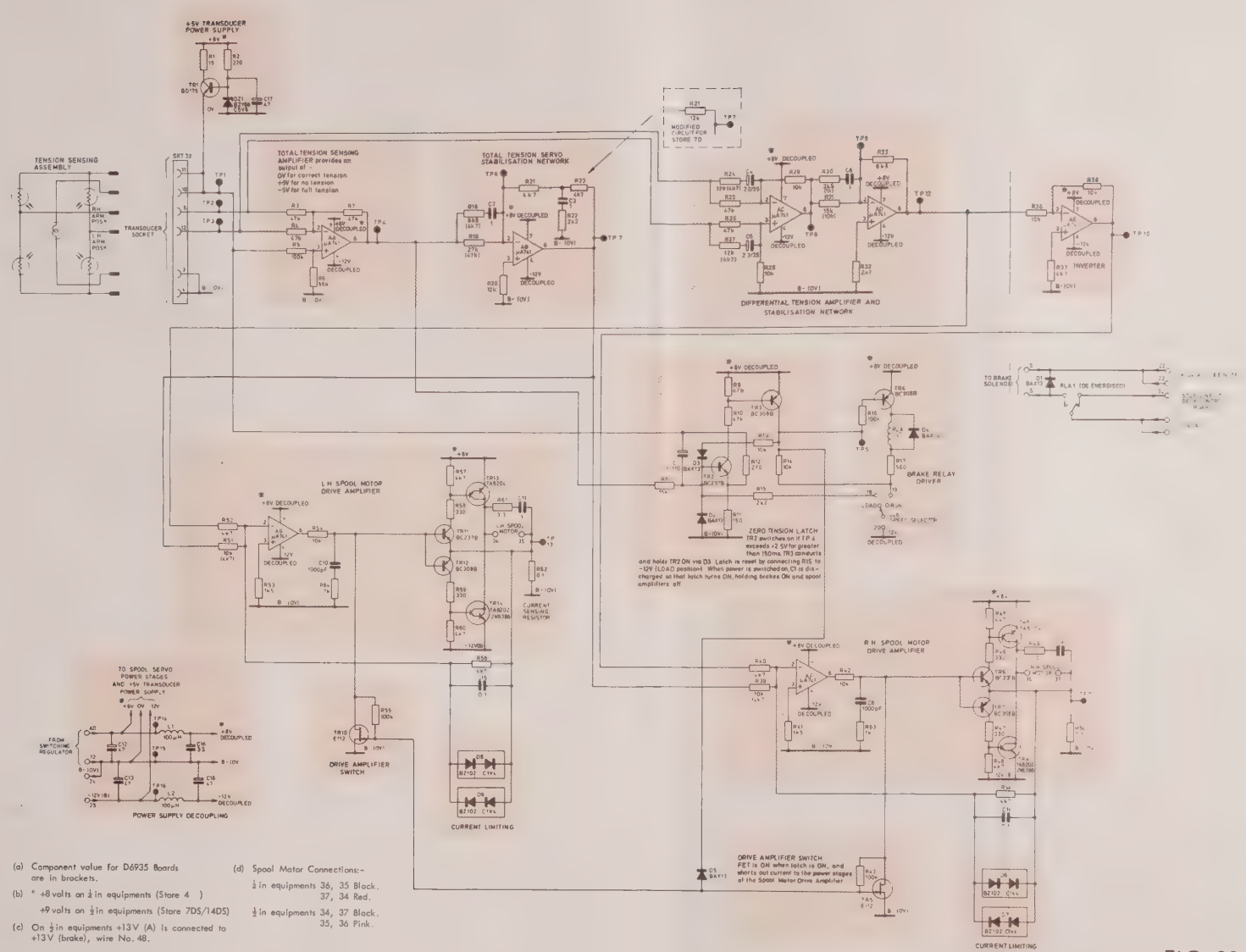


FIG. 32 SPOOL SERVO BOARD - LAYOUT

Store 14DS
Sept. 1982


+5V TRANSDUCER POWER SUPPLY
TENSION SENSING ASSEMBLY
TRANSDUCER SOCKET
TOTAL TENSION SENSING AMPLIFIER provides an output of :- 0V for correct tension +5V for no tension -5V for full tension
TOTAL TENSION SERVO STABILISATION NETWORK
MODIFIED CIRCUIT FOR STORE 7D
DIFFERENTIAL TENSION AMPLIFIER AND STABILISATION NETWORK
INVERTER
TO BRAKE SOLENOID
BRAKE RELAY DRIVER
ZERO TENSION LATCH
L.H SPOOL MOTOR DRIVE AMPLIFIER
CURRENT SENSING RESISTOR
DRIVE AMPLIFIER SWITCH
CURRENT LIMITING
R.H SPOOL MOTOR DRIVE AMPLIFIER
TO SPOOL SERVO POWER STAGES AND +5V TRANSDUCER POWER SUPPLY
FROM SWITCHING REGULATOR
POWER SUPPLY DECOUPLING
DRIVE AMPLIFIER SWITCH FET is ON when latch is ON, and shorts out current to the power stages of the Spool Motor Drive Amplifier

NOTES:

(a) Component value for D6935 Boards are in brackets.

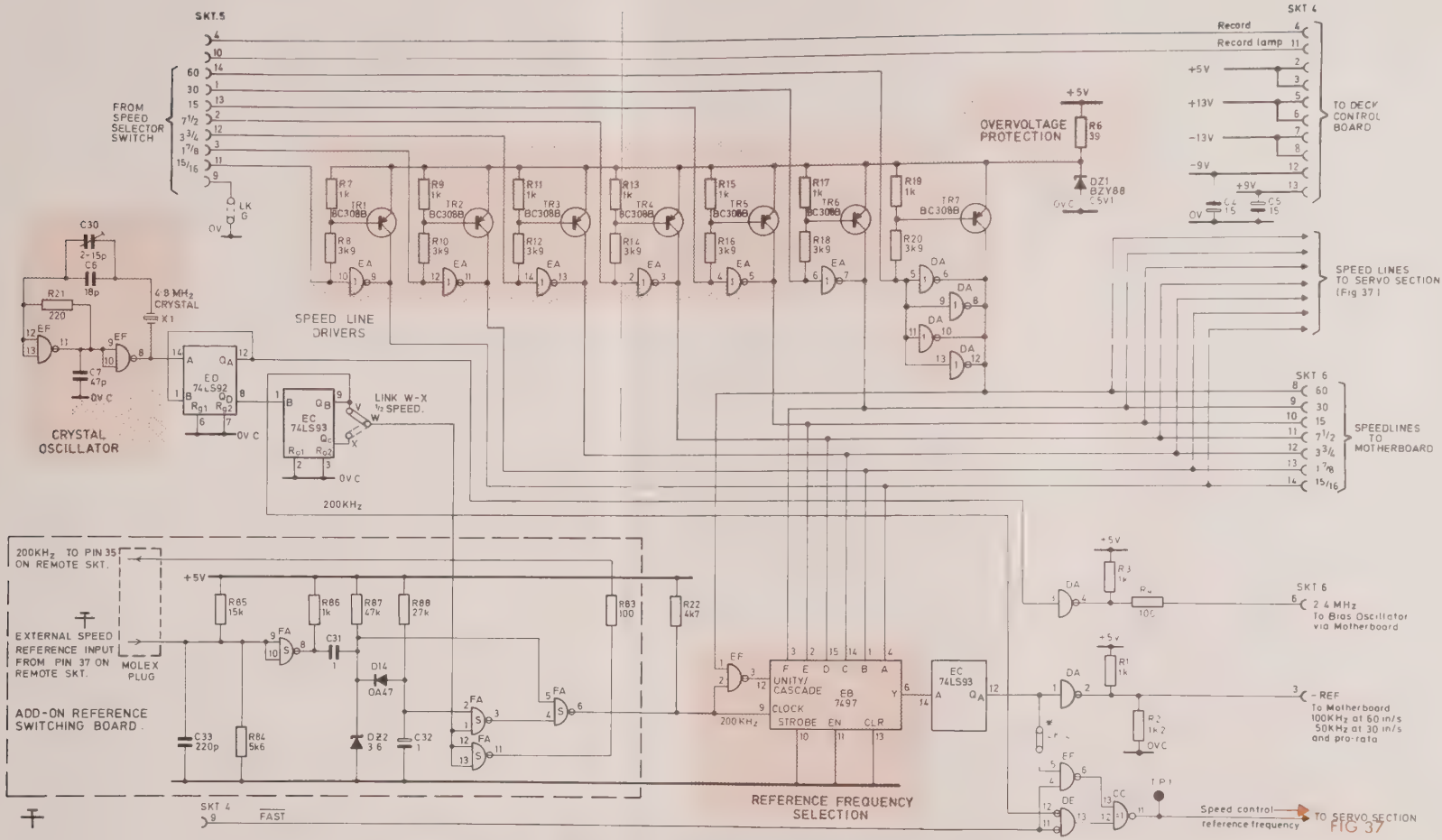
(b) * +8 volts on ¼in equipments (Store 4)
+9 volts on ½in equipments (Store 7DS/14DS)

(c) On ½in equipments +13V (A) is connected to +13V (brake), wire No. 48.

(d) Spool Motor Connections:-
¼in equipments 36, 35 Black. 37, 34 Red.
½in equipments 34, 37 Black. 35, 36 Pink.

Store 14DS
Sept. 1982

FIG.33
SPOOL SERVO BOARD - CIRCUIT



A TTL 5V signal will override the internal crystal reference.

A 200kHz input will give standard speed as set by speed selector.

This may be varied by up to ±30%.

*EXTERNAL SPEED CONTROL
EXTERNAL SIGNAL CAN BE FED IN AT LINK L OR REMOTE SKT PIN 37 (SEE OPERATING INSTRUCTIONS)

INTEGRATED CCT	DESIGNATION	SUPPLY 0V PIN Nos	SUPPLY Vcc PIN Nos	INTEGRATED CCT	DESIGNATION	SUPPLY 0V PIN Nos	SUPPLY Vcc PIN Nos
MC4044P	AA	7	14	SN7402N	DE	7	14
SN74122N	AB	7	14	SN74LS132	DF, FA	7	14
SN74LS74	AC	7	14	8T98	EA	8	16
SN74LS03	CA	7	14	SN7497N	EB	8	16
SN7408	CB	7	14	SN74LS93	EC	10	5
SN7486	CC	7	14	SN74LS92	ED	10	5
SN7416	DA	7	14	SN7400	EF	7	14
SN74LS05	DB	7	14				

Store 14DS
November 1979

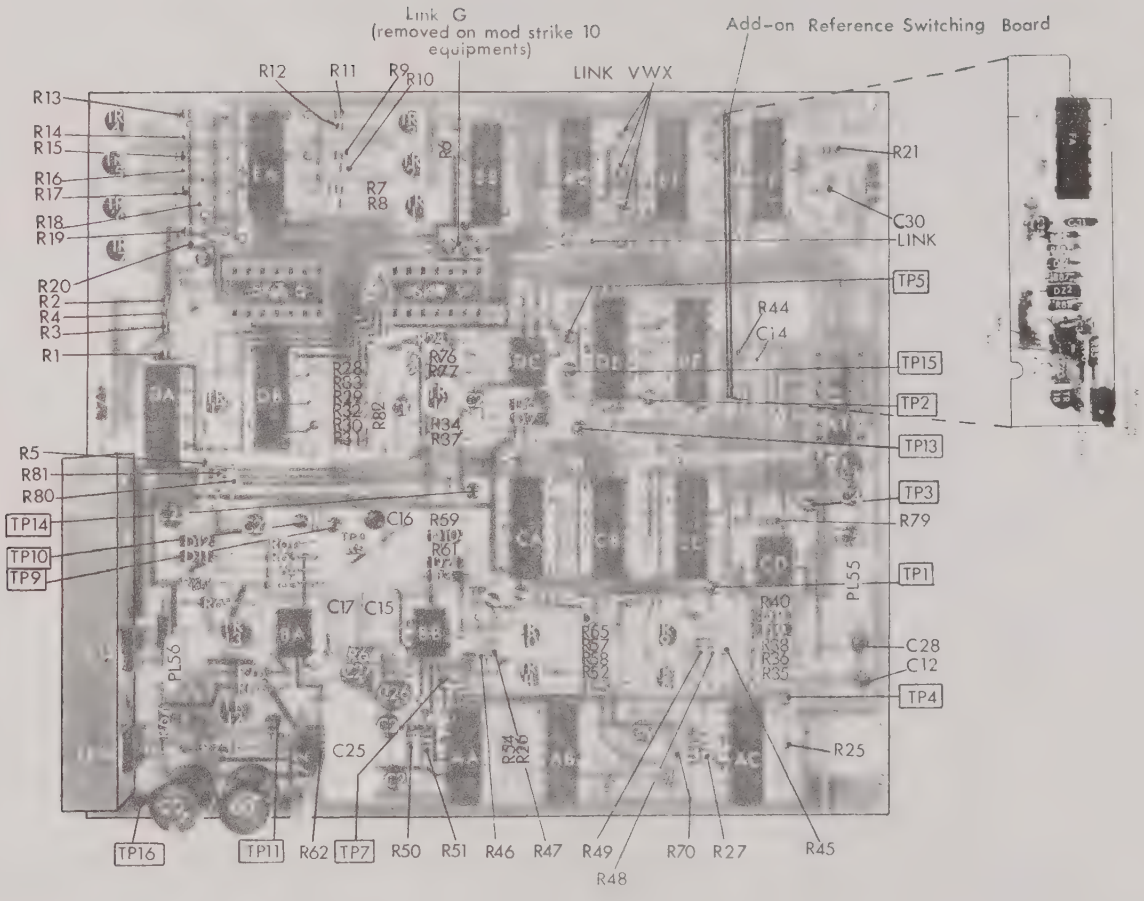
FIG. 34
CAPSTAN SERVO BOARD - CIRCUIT
(Oscillator Section)

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	CAPSTAN SERVO			D7708
Capacitors				
C1	47 µF	20%	10 V	Cat 13433
C2, 3	100 µF	20%	25 V	Cat 14431
C4, 5	15 µF	20%	10 V	Cat 14211
C6	18 pF	2%	63 V	Cat 14220
C7	47 pF	2%	63 V	Cat 11615
C8, 10, 29	1 µF	20%	35 V	Cat 12035
C9, 14	2, 200 pF	10%	100V	Cat 13646
C11, 13	150 pF	2%	63 V	Cat 13645
C12	3.3µF	20%	16 V	Cat 13122
C15	0.047 µF	10%	250 V	Cat 13430
C16	2.2 µF	20%	16 V	Cat 12036
C17	0.22 µF	10%	100 V	Cat 13432
C18, 19, 22, 23	22 µF	20%	16V	Cat 13434
C20, 21	10 µF	20%	16V	Cat 12037
C24	680 pF	10%	100 V	Cat 13422
C25	1 µF	10%	100 V	Cat 12725
C26, 27	47 µF	20%	16 V	Cat 13467
C28	0.47 µF	20%	35 V	Cat 13648
C30	2 - 15 pF	Trimmer capacitor		Cat 14171
Crystal				
X1	4.8 MHz			Cat 13924
Diodes				
D1, 2, 3	OA200			Cat 2874
D4, 5, 13	OA47			Cat 2852
D6 - 12	BZ102C1V4			Cat 12648
Diode Zener				
DZ1	BZY88 C5V1		5.1V	Cat 8407
Integrated Circuits				
AA	MC4044P			Cat 11959
AB	SN74122N			Cat 11944
AC	SN74LS74N			Cat 15073
BA, BB	µA 741CV			Cat 9796
CA	SN74LS03N			Cat 11407
CB	SN7408N			Cat 12084
CC	SN7486N			Cat 11953
CD, DC	LM301AN			Cat 12517
DA	SN7416N			Cat 12098
DB	SN7400N			Cat 9161
DE	SN7402N			Cat 9171
DF	SN74LS132N			Cat 14041
EA	8T98			Cat 14302
EB	SN7497N			Cat 11406
EC	SN74LS93N			Cat 15076
ED	SN74LS92N			Cat 15075
EF	SN7400N			Cat 9161

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	CAPSTAN SERVO (Contd)			D7708
Plugs				
PL55, 56	5 Way			Cat 14181
Resistors				
R1, 3, 7, 9, 11, 13, 15, 17, 19, 26, 44, 65, 67, 71	1k	5%	¼ W	R10102
R2	1k2	5%	¼ W	R10122
R4, 41, 74, 75	100Ω	5%	¼ W	R10101
R5, 28	1k5	5%	¼ W	R10152
R6	39Ω	5%	¼ W	R10390
R8, 10, 12, 14, 16, 18, 20	3k9	5%	¼ W	R10392
R21, 66, 68, 69	220Ω	5%	¼ W	R10221
R22, 24, 45, 46, 47, 70	4k7	5%	¼ W	R10472
R25	470Ω	5%	¼ W	R10471
R27	8k2	2%	¼ W	R10822
R29	3k3	5%	¼ W	R10332
R30, 60	6k8	5%	¼ W	R10682
R31, 36, 64	15k	5%	¼ W	R10153
R32	33k	5%	¼ W	R10333
R33, 40, 48, 52 53, 55, 63, 39	100k	5%	¼ W	R10104
R34, 56, 62, 78, 79	10k	5%	¼ W	R10103
R35	43k	5%	¼ W	R10433
R37, 38, 54, 59 61, 80, 81	2k2	5%	¼ W	R10222
R42, 43	390Ω	5%	¼ W	R10391
R49, 50, 51	22k	5%	¼ W	R10223
R57, 58	10M	10%	¼ W	R10105
R72	1Ω	5%	2.5W	Cat 7913
R73	3.3Ω	5%	¼ W	R10339
R77	1M	10%	¼ W	R10105
R76, 82	220k	5%	W	R10224
Sockets				
SKT4, 5, 6	14 way	D.I.L.		Cat 12782
Terminal Assembly				
25 off	Vero 22435			Cat 13746
5 off	Vero 22436			Cat 13747
Transistors				
TR1 - 8, 11, 13	BC308B			Cat 11977
TR9, 10, 12, 16, 17	BC237B			Cat 11978
TR14	BD176			Cat 12381
TR15	BD175			Cat 11980

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	VARIABLE SPEED INTERFACE			DB667
	Add-on board to Capstan Servo			D7708
Capacitor				
C31	0.1 µF	-20% +80%	100 V	Cat 12321
C32	0.1 µF	20%	35 V	Cat 13782
C33	220 pF	20%	63 V	Cat 10357
C34	10 µF	20%	16V	Cat 12037
Diode				
D14	OA47			Cat 2852
Diode Zener				
DZ2	BZY88		C3V6	Cat 12647
Integrated Circuit				
FA	SN74LS132			Cat 14041
Resistors				
R83	100	5%	¼ W	R10101
R84	5k6	5%	¼ W	R10562
R85, 89, 91	15k	5%	¼ W	R10153
R86	1k	5%	¼ W	R10102
R87	47k	5%	¼ W	R10473
R88	27k	5%	¼ W	R10273
R90	4k7	5%	¼ W	R10472
Transistor				
TR18	BC237B			Cat 11978

Fig.35 CAPSTAN SERVO BOARD - PARTS LIST D7708/3



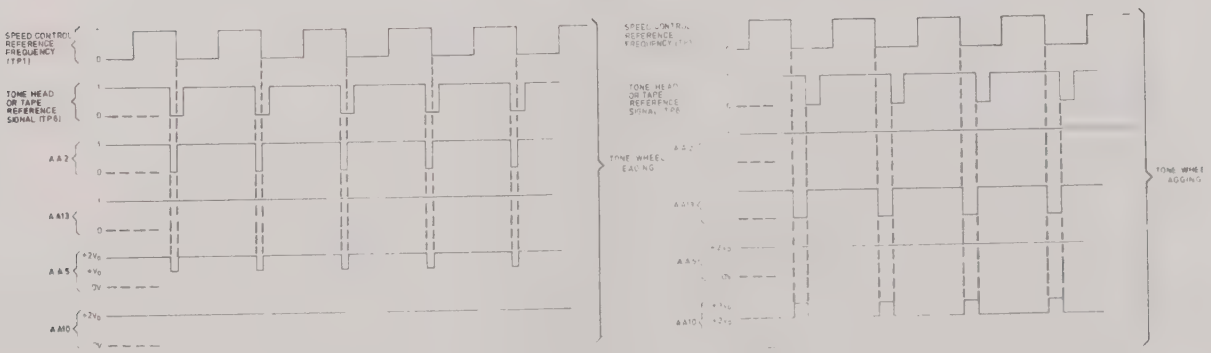


FIG. 36 CAPSTAN SERVO BOARD - LAYOUT
D7708/3

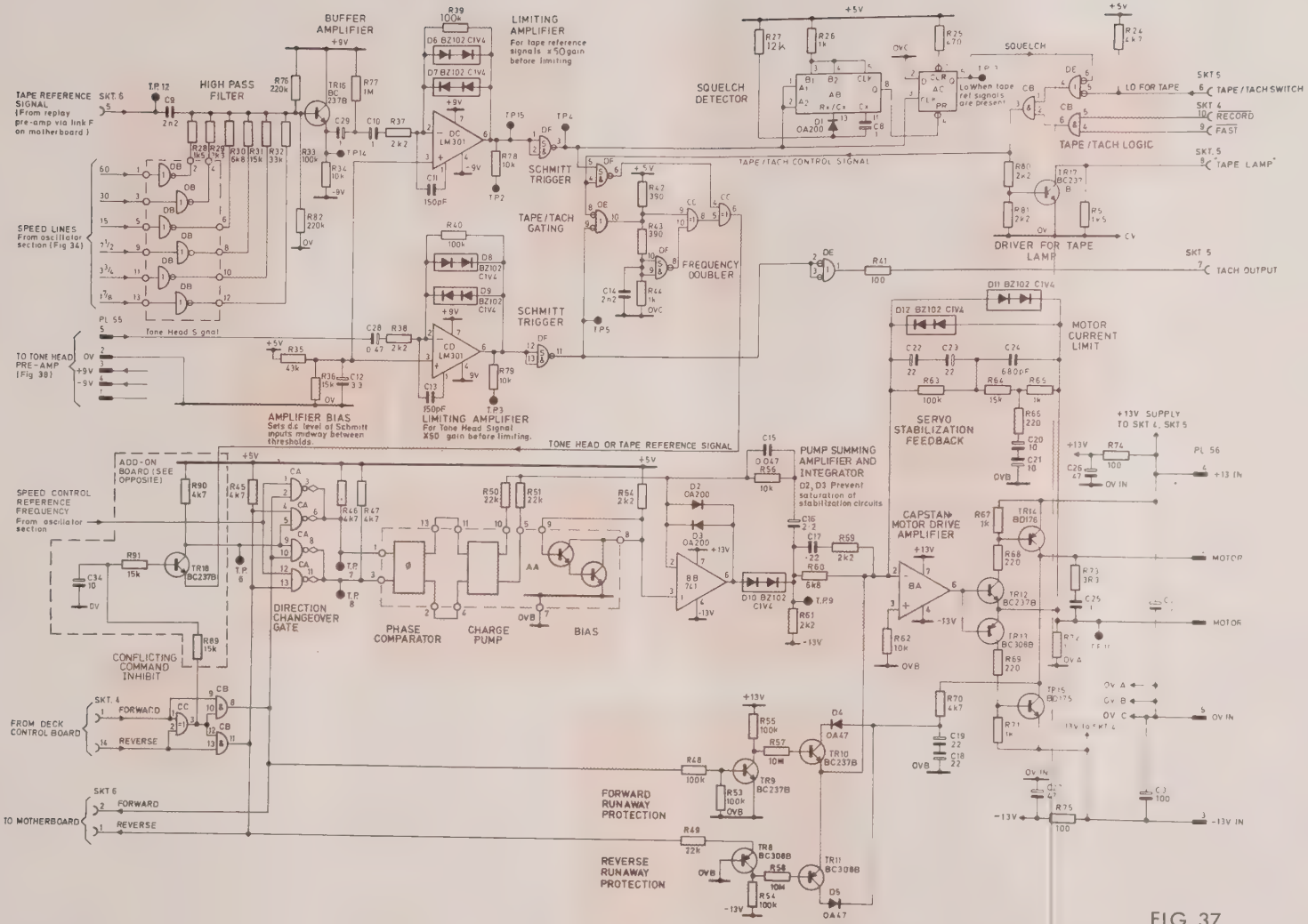
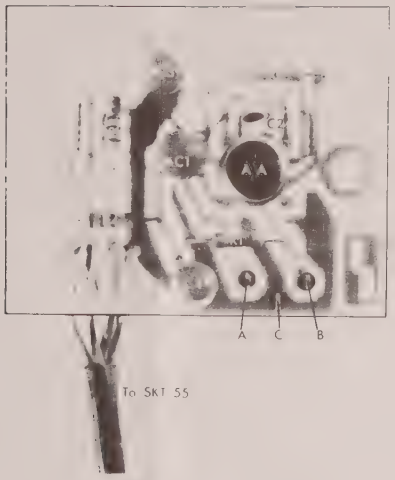
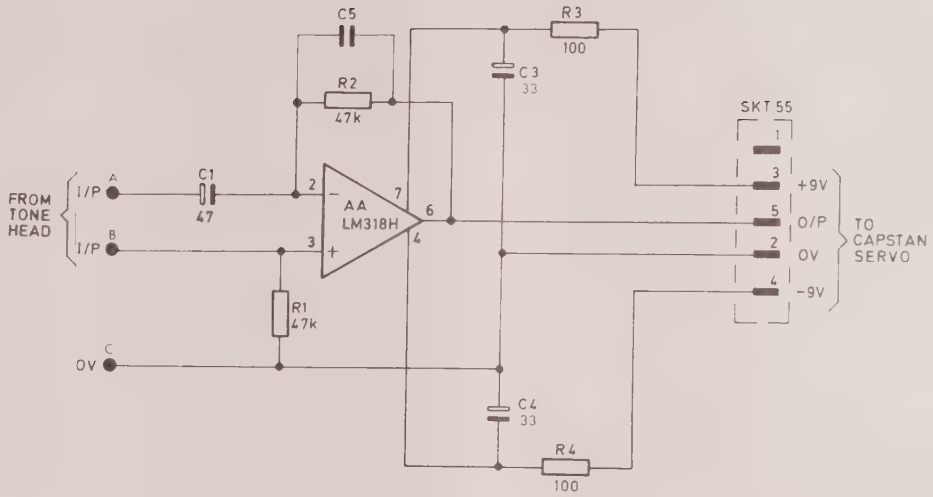


FIG.37

CAPSTAN SERVO BOARD - CIRCUIT
(Servo Loop Section)

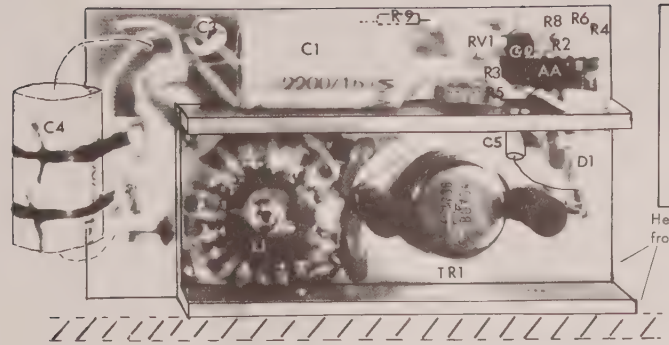
Store 14DS
November 1979



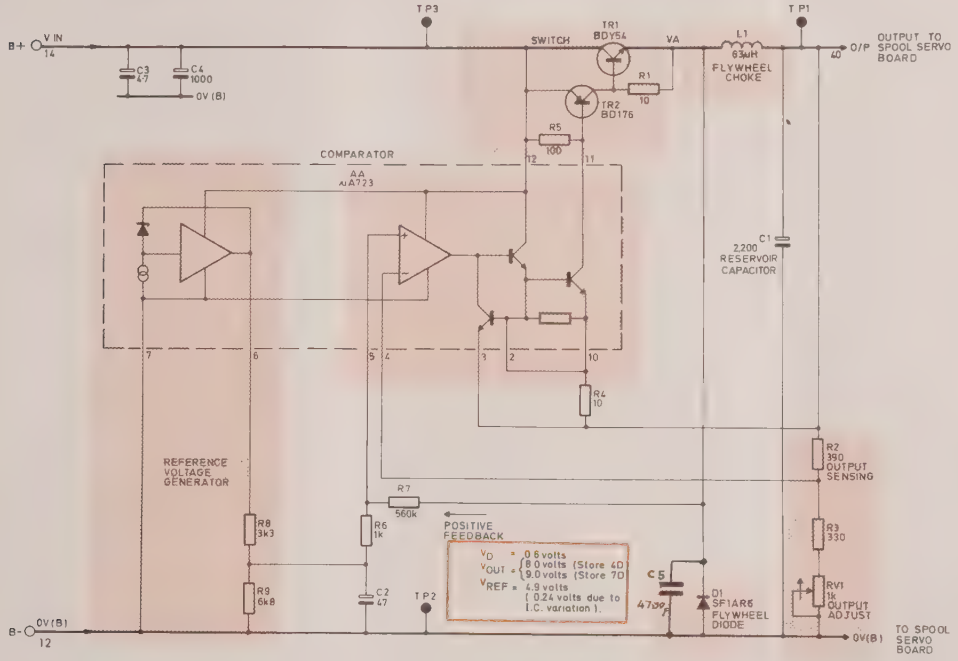


CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	TONE HEAD PREAMPLIFIER			D7697
Capacitors				
C1	47µF	20%	10V	Cat 13433
C3,4	33µF	20%	16V	C163330
C5	4.7pF	5%	63V	Cat 13713
Integrated Circuit				
AA	LM318H			Cat 9982
Resistors				
R1, 2	47k	5%	¼W	R10473
R3, 4	100	5%	¼W	R10101
Socket				
SKT55	Housing			Cat 12794
	Contact	14 off		Cat 14191
Terminal Assembly				
3 off	Vero 22436			Cat 13747

FIG.38 TONE HEAD PREAMPLIFIER LAYOUT AND CIRCUIT D7697



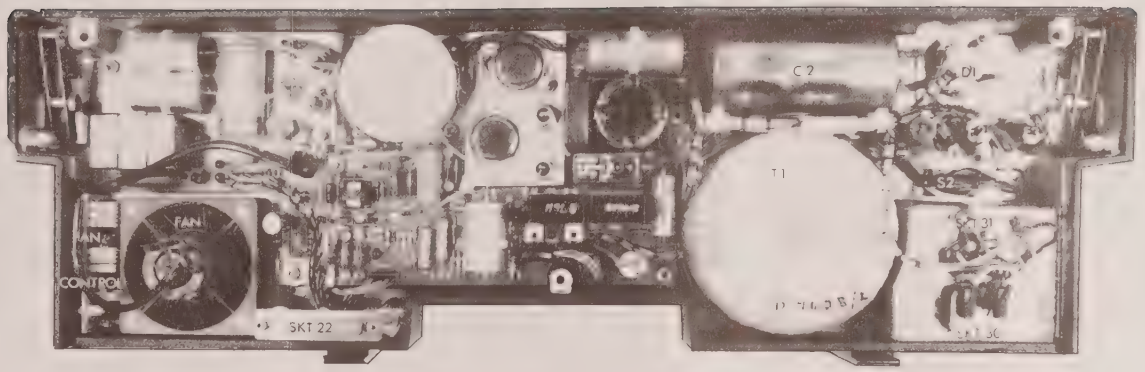
When the transistor switch is ON, $V_A = (V_{IN} - 1)$ volts (due to drop across switch). V+ will be V_{REF} + a fraction of V_A due to R7. For V_{IN} = 20V, V_A = 19V, V+ = (V_{REF} + 0.025) volts. The output rises until V- exceeds V+ when the switch turns OFF. The choke "flywheels" and D1 conducts with a voltage drop V_D = 0.6V. V_A = -0.6V therefore, and V+ = (V_{REF} -0.01) volts. The output decays until V+ exceeds V- when the switch turns ON again. Operating frequency 20kHz - 40kHz.



CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	SWITCHING REGULATOR			D7725 2
Capacitors				
C1	2200μF	-20% +50%	16V	Cat 13425
C2	47μF	20%	10V	Cat 13433
C3	4.7μF	20%	50V	Cat 13795
C4	1000μF	-10% +50%	35V	Cat 13470
C5	4700pF	25%	100V	Cat 11610
Choke				
L1	63μH			D7615
Diode				
D1	Westinghouse SF1AR6			Cat 12643
Integrated Circuit				
AA	Signetics N5723A			Cat 12099
Potentiometer				
RV1	1k Bourns VA05V			Cat 11938
Resistors				
R1, 4	10Ω	5%	¼W	R10100
R2	390Ω	5%	¼W	R10391
R3	330Ω	5%	¼W	R10331
R5	100Ω	5%	¼W	R10101
R6	1k	5%	¼W	R10102
R7	560k	5%	¼W	R10564
R8	3k3	5%	¼W	R10332
R9	6k8	5%	¼W	R10682
Transistors				
TR1	Sesco BDY54			Cat 12384
TR2	Telefunken BD176			Cat 12381
Heatsink				P14852
Diode Mounting Kit	Mullard 56295			Cat 7097
Transistor Insulating Kit	Mica Washer Mullard 56201B Sleeving, Hellerman			Cat 7073 Cat 2052
Terminal				Cat 13745

FIG. 39
SWITCHING REGULATOR BOARD LAYOUT AND CIRCUIT D7725/2

CIRC. REF.	VALUE	TOL	RATING	MFRS REF
	REAR CASTING ASSEMBLY			
General Items				
	Cableform			
	Diode, Bridge Rectifier Varo VL148			Cat 4403
	Fuseholder			Cat 210
	Grommet			Cat 4632
	Insulating card			P16461
	Power Supply Board			D7736
Capacitors				
C2	10,000μF	20%	40V	Cat 12034
C3	0.47μF	20%	100V	Cat 10346
Fan Assembly				
	Fan			Cat 12776
	Fan Control Board			D7738
Filter				
	Grill			P16447
	Filter material Penair 20 PPI			
Fuses				
F1 or F1	1A 2A		230V 115V	Cat 4301 Cat 4304
F2 F3	10A 10A	D7630-2		Cat 4315 Cat 4311
Sockets				
SKT30	(mains) Belling Lee L1950			Cat 11538
SKT31	(DC) Belling Lee L1349 CP			Cat 11545
	Switch, Voltage Selection			Cat 11540
Transformer				
T1	Mains, Toroidal			D7608-2



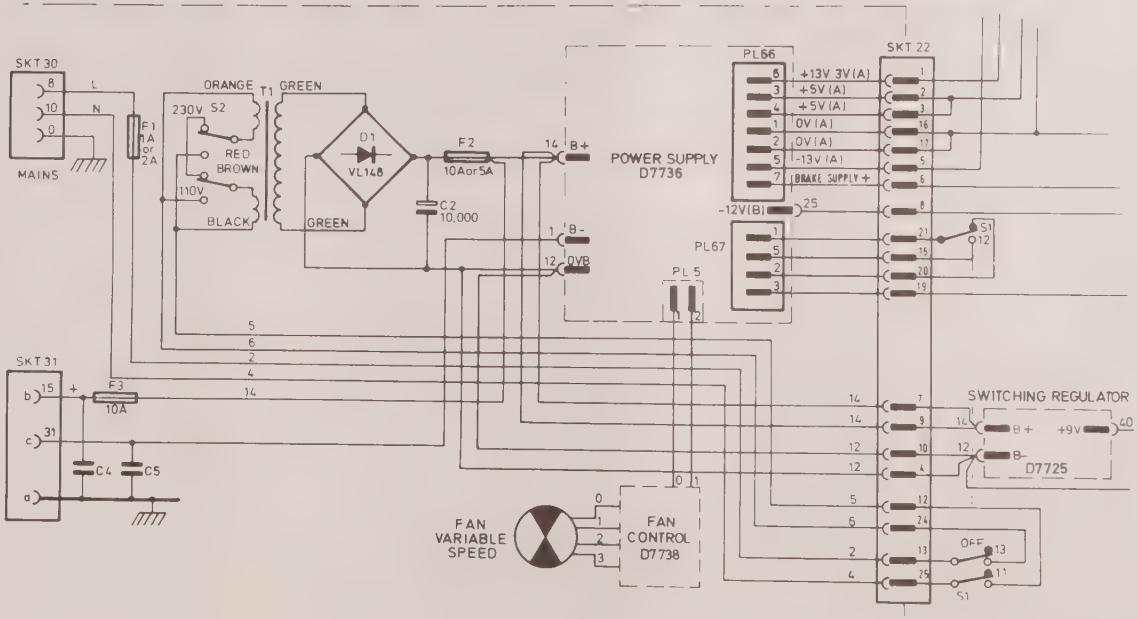
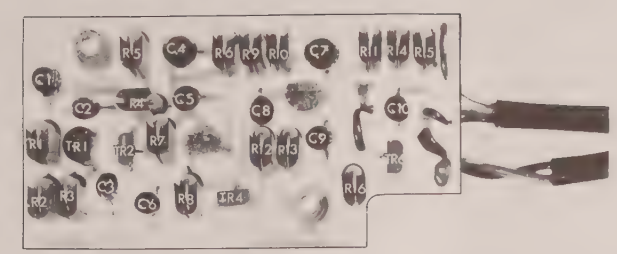
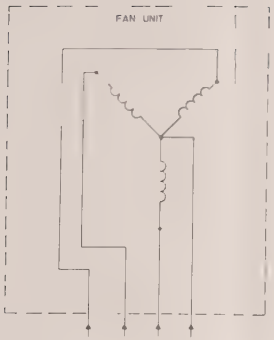
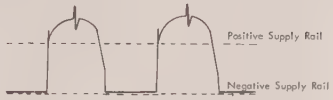


FIG. 40 REAR CASTING ASSEMBLY - LAYOUT AND CIRCUIT D7630/2







Waveform at collectors of TR2, TR4, and TR6.
Voltage and Frequency are proportional to the applied voltage at SKT65 which should be between 4 volts and 12 volts
At less than approximately 4 volts applied, i.e. when the equipment is cold, the fan will not rotate

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	FAN CONTROL BOARD			D7738
Capacitors				
C1, 4, 7	15µF	20%	25V	Cat 13781
C2, 5, 8	0.22µF	20%	35V	Cat 14333
C3, 6, 9	2.2µF	20%	35V	Cat 13466
C10	0.47µF	20%	35V	Cat 13648
[illegible] Resistors				Cat 14111
Resistors				
R1	47k	5%	¼W	R10473
R2, 7, 12	100k	5%	¼W	R10104
R3, 8, 13	680Ω	5%	¼W	R10681
R4, 9, 14	22k	5%	¼W	R10223
R5, 10, 11, 16	33k	5%	¼W	R10333
R6	39k	5%	¼W	R10393
R7	150Ω	5%	¼W	R10151
Socket				
SKT65	Socket Housing 2 Way Contact Crimp, 2 off			Cat 14769 Cat 14191
Transistors				
TR1, 3, 5	BC308B			Cat 11977
TR2, 4, 6	ZTX450			Cat 13628

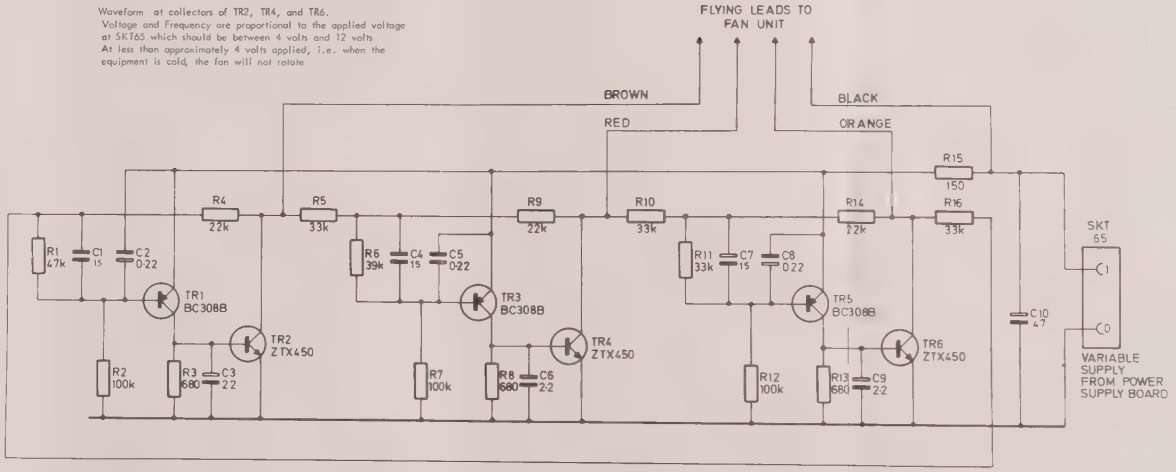


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FIG.41
FAN CONTROL BOARD - LAYOUT AND CIRCUIT
D7738

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	POWER SUPPLY BOARD			D7736-1 D7736-2
Capacitors				
C2	47µF	20%	10V	C162470
C3	1000µF	-20% +50%	6.3V	Cat 14435
C4	2200µF	-10% +50%	35V	Cat 13137
C5	15µF	-10% +50%	40V	Cat 4219
C6, 14	0.47µF	20%	35V	C166478
C7	0.01µF	-20% +80%	100V	Cat 13427
C8	2.2µF	10%	100V	Cat 9713
C9	4.7µF	10%	160V	Cat 13429
C11	2200µF	-20% +50%	16V	Cat 13425
C12, 16	10µF	20%	16V	C163100
C12, 16	1000µF	-10% +50%	35V	Cat 13470
C18	10,000µF	-20% +50%	6.3V	Cat 14432
C20	100µF	20%	25V	Cat 14431
C22	100pF	2%	63V	Cat 10476
C23	2.2µF	20%	35V	C166229
C24, 25	0.47µF	20%	100V	Cat 10346
C26	4700pF	10%	100V	Cat 13647
Chokes				
L1	210mH			D7610
L2, 3, 5, 6	120mH			D7611
L4	56µH			Cat 11670
L7	100µH			Cat 11679
Diodes				
D1, 4	3051			Cat 12385
D2, 3, 8, 12, 13, 15, 16	1N4002			Cat 9660
D5	S1AN12			Cat 11975
D6, 7	SF1AR12			Cat 12643
D9, 10, 11	SF1AN6			Cat 12386
D14	BAX13			Cat 8406
Diodes Zener				
DZ1	1N5258B			Cat 15066
DZ2	BZY88	C4V7		Cat 840
DZ4	BZY88	C6V2		Cat 2844
Intergrated Circuit				
AA	N5723A (Voltage Regulator)			Cat 12099
Plugs				
PL65	Plug Molex 22-04-1021			Cat 14952
PL66	Plug Molex 22-04-1071			Cat 14499
PL67	Plug Molex 22-04-1051			Cat 14181
Potentiometer				
RV1	2k2	Cermit VA05H		Cat 13844
Relay				
RLA				Cat 13366

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	POWER SUPPLY BOARD (Contd)			D7736-1 D7736-2
Resistors				
R1, 2, 9, 13, 26	100	5%	¼W	R10101
R3	330	5%	¼W	R10331
R4	47	5%	¼W	R10470
R5, 20, 25, 27, 30	1k	5%	¼W	R10102
R6, 32	1B	5%	3W	Cat 11987
R8	2R2	5%	3W	Cat 12624
R10	22k	5%	¼W	R10223
R11	2k7	5%	¼W	R10272
R12	2k2	5%	¼W	R10222
R14	100	5%	3W	Cat 8167
R15	0R2	5%	3W	Cat 9286
R16	10	5%	¼W	R10100
R17	220	5%	¼W	R10221
R18, 23	680	5%	¼W	R10681
R19	3k9	5%	¼W	R10392
R21(D7736-1)	330k	5%	¼W	R10334
R21(D7736-2)	150k	5%	¼W	R10154
R22, 30a	1k5	5%	¼W	R10152
R25	4k7	5%	¼W	R10472
R28	270	5%	¼W	R10271
R30b	1k8	5%	¼W	R10182
R31	120	5%	¼W	R10121
Set on Test Resistor, if fitted	In range 0R1 to 1R3	5%	¼W	
Terminals				
4 off	Terminal, Faston Tab, Hellerman HC8150T			Cat 13745
11 off	Terminal Assembly Vero 22436			Cat 13747
Thermistor				
TH1	Thermistor Assembly			D7612/2
Thyristor				
CSR1	12RCM10 or BTY 87		100R	Cat 12391

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	POWER SUPPLY BOARD (Contd)			D7736-1 D7736-2
Transformers				
T1	Converter			D7609
T2	Timing			D7257
T3	ITT			Cat 13840
Transistors				
TR1	BC308B			Cat 11977
TR3	Unijunction 2N2646			Cat 10127
TR4, 5	BDY58			Cat 13204
TR6, 9	BD175			Cat 11980
TR7	BC237B			Cat 11978
TR8	ZTX554			Cat 13847
Transistor and Diode Mounting Items				
	Heat sink			P16036
	Heat sink Compound			Cat 8274
	Insulating Bush - Transistors			Cat 11903
	Mica Washer - Transistor			Cat 7073
	Mounting Kit - Diode			Cat 7097
	Pad - Mounting			Cat 11548
	Pad - Mounting			Cat 11554

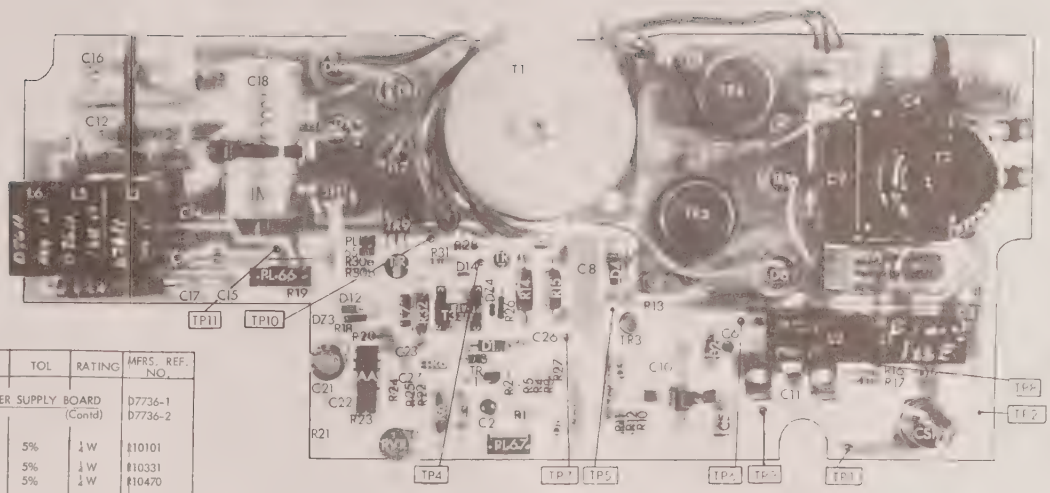

FIG. 42 POWER SUPPLY BOARD - LAYOUT D7736/2

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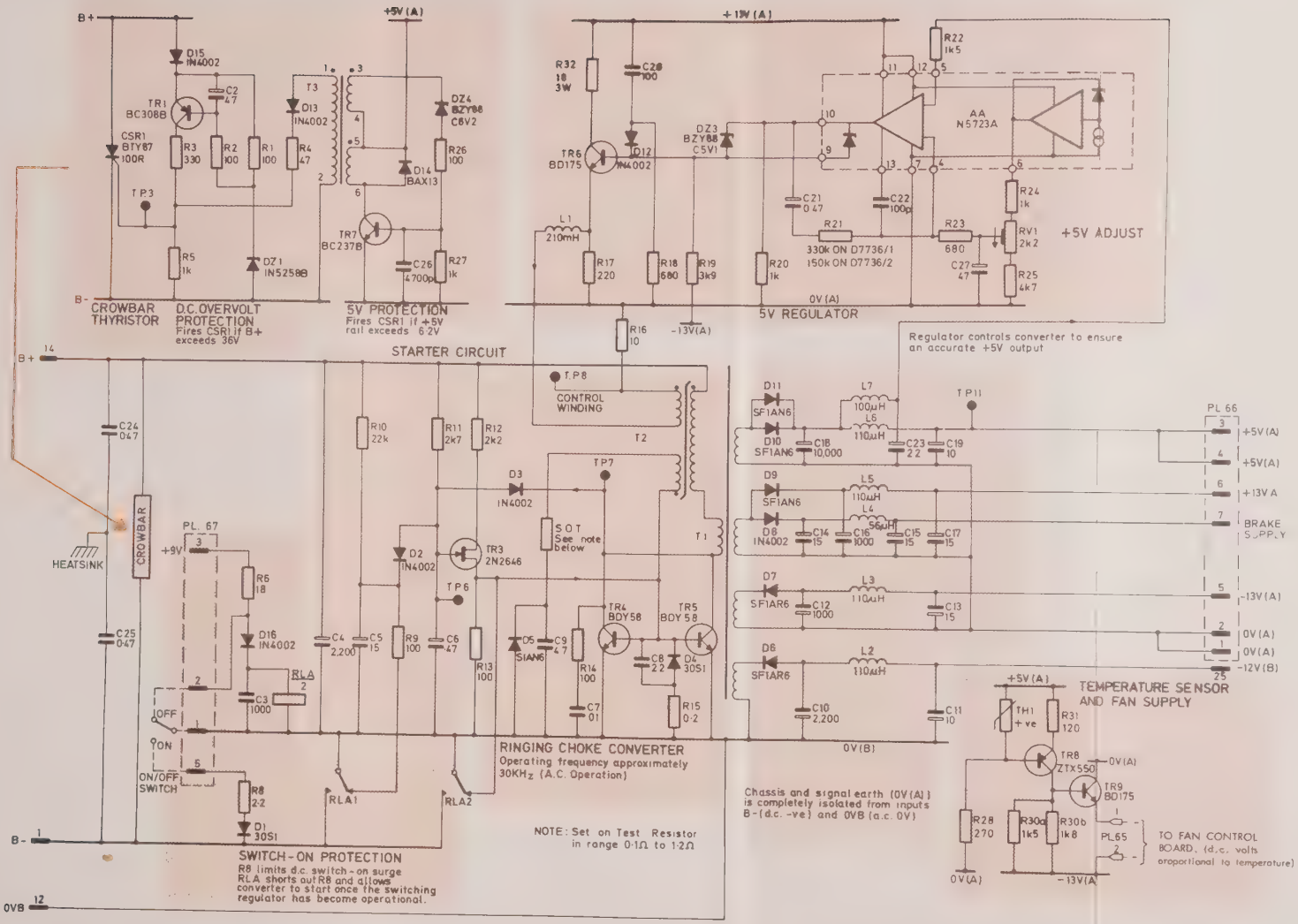
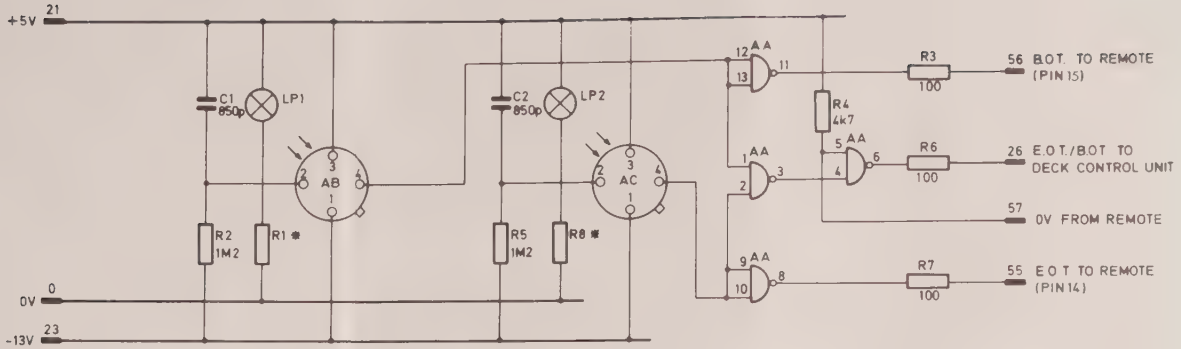


FIG.43
POWER SUPPLY BOARD - CIRCUIT



CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	EOT/BOT SENSOR BOARD			
Capacitors				
C1, C2	820pF	10%	200V	Cat 13128
Integrated Circuit				
AA	SN74LS00N			Cat 15077
Lamps				
LP1, LP2	Vitality	V680		Cat 8599
Photocell				
AB.AC	IPL1500AO Integrated Photo Matrix Ltd. (WARNING MOS DEVICES)			Cat 11758
Resistors				
R1, R8	S.O.T.	5%	¼W	
R2, R5	1M2	5%	¼W	R10125
R3, R6, R7	100Ω	5%	¼W	R10101
R4	4k7	5%	¼W	R10472

* SELECT ON TEST
VALUE BETWEEN 15R AND 100R.

WARNING

MOS DEVICES

This circuit contains MOS devices. To eliminate the possibility of damage by static electricity the handling of electronic components or tracks on the printed circuit board must be avoided

Test equipment, soldering irons etc., must be earthed before being used on this circuit

FIG. 44
EOT/BOT - CIRCUIT AND PARTS LIST
D6501/2

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	BRAKE ASSEMBLY			
				D8175
	Brake Assembly { Store 7D / Store 14 / Store 14D }			D8176
	Pad Assembly (All models)			D8178
	BRAKE SOLENOID DRIVER BOARD			D8267
Capacitor				
C1	2.2μF	20%	35V	Cat 13466
Diode				
D1	1N4002			Cat 9660
Diode Zener				
DZ1	5ZS5 6B			Cat 15068
Intergrated Circuit				
AA	NE 555V			Cat 11404
Resistors				
R1	100k	5%	¼ W	R10104
R2	680Ω	5%	¼ W	R10681
R3	39Ω	5%	2½ W	Cat 9290

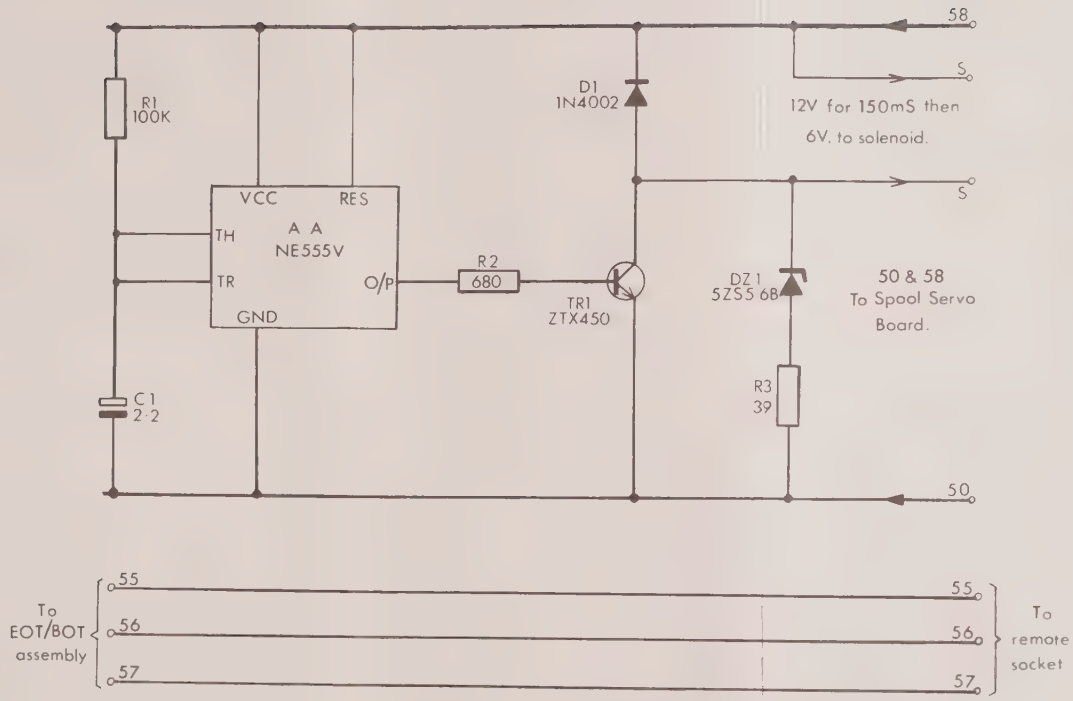


FIG.45
BRAKE SOLENOID DRIVER
CIRCUIT AND PARTS LIST

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF NO.
	STORE 14DS			D8300
ACCESSORIES				
Connectors				
1 off	Connector, Mains Lead			Cat 11728
1 off	Plug, D.C. Supply			Cat 8429
28 off	Plug, Coaxial BNC			Cat 4858
1 off	Plug, Remote Control 37 way			Cat 4820
2 off	Plug, 15 way			Cat 1339
1 off	Socket, 15 way			Cat 2206
General items				
1 off	Microphone/Loudspeaker Assembly			D5846
1 off	Muff, Protector			Cat 11470
1 roll	Tape, Reflective Marker			Cat 10331
1 off	Spool, Empty			Cat 2300
1 off	Tape on Spool			Cat 15290
1 off	Technical Handbook			Cat 15246
MAIN ASSEMBLY				
	Base Cover			D8261
	Deck Cover (Transparent)			D8099
	Facia Cover			P15237
	Front and Top Cover Assembly			D8657
	Handle			D7447
	Handle Runner			D5838
	Head Cover			P16021
Connectors	(Chassis Mounting)			
PL22	25 Way			Cat 1336
PL23,27	15 pin			Cat 1339
SKT28	15 pin			Cat 2206
SKT25	37 pin			Cat 8430
SKT26	5 pin DIN			Cat 10238
28 off	Plug Coaxial BNC			Cat 12012
SUB ASSEMBLIES				
	(For printed circuit boards, refer to index for appropriate figure).			
Brake Assembly				D8176 *
2 off	Brake Pad Assembly			D8178

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	STORE 14DS			D8300/3
SUB ASSEMBLIES	(Contd)			
Capstan Assembly				D7723
Counter Assembly				D5816
	Counter			Cat 4223
	Counter Drive Ring			Cat 1863
	Pulley			P13867
EOT/BOT Assembly				D6932
Head Plate Assembly				D8312 *
Meter Assembly	(See Fig. 26)			D7979
Meter Selector Assembly				D7446 *
	Switch, micro, Burgess V4T2 (Operated by meter selector in R.H. position).			Cat 2384
Push Button Assembly				D5815
	Bracket (Mounting)			P13868
	Lamp 14V, 0.04A midget, flange base			Cat 8600
	Push Buttons "<<"			P14270
	Push Button "<"			P14272
	Push Button "STOP"			P14268
	Push Button ">"			P14273
	Push Button ">>"			P14271
5 off	Switch TMC dialight 513-0101-604			Cat 12125
Rear Casting Assembly				D7630/2

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF NO.
	STORE 14DS			D8300/3
SUB ASSEMBLIES	(Contd)			
Speed Selector Assembly				D5815
	Bracket (Mounting)			P13863
	Bracket (Switch)			P13864
	Knob			Cat 12163
	Push Button "RECORD"			P14269
S1	Switch (Rocker)			Cat 15189
S4	Switch (Rotary)			Cat 12131
S5	Switch (Push) TM (dialight) 513-0101-604			Cat 12127
Spool Drive Assembly				D6941
Switch Assemblies				
	Flutter Compensation Switch Assembly			D8338/4
	Bracket			P16740/2
LP2	Lamp 6V 0.1A			Cat 13731
	Lamp Holder, clear			Cat 4770
S13	Switch, sub-minature			Cat 12745
S12	Switch, Toggle			Cat 12759
	Local Enable and Tape Switch Assembly			D8669/2
	Bracket			P17276/2
	Lamp 14V 0.04A			Cat B600
	Lamp Holder, clear			Cat 4770
	Switch, Toggle			Cat 12759
Tension Arm Assembly				D6954
	Lamp 5V, 0.06A, Vitality V680			Cat 8599
	Photocell P.C. Boards Assembly			D5811
	Spring (Red)			P15251
	Spring (Black)			P15352

* The items which make up this unit come as a complete assembly and cannot be supplied separately.

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF NO.
	TOOLS, SPARES AND OPTIONAL ITEMS (Not supplied with basic equipment)			
Boards				
	Calibration (Reference) Board			D7720
	Extender Boards for:-			
	F.M. Record/D.R. Record			D6502/2
	F.M. Replay/D.R. Replay 1			D6503
	F.M. Filter/D.R. Replay 2			D6504.2
	Set of F.M. Boards for one F.M. DS channel			D8285/2
	Set of D.R. Boards for one channel			D7741/2
Tools etc.				
	Allen Keys:-			
	1.5mm			523/00/557
	2.5mm			523/00/558
	3.0mm			523/00/701
	Pozidriv Screwdrivers			
	Point 0			523/00/647
	Point 1			523/00/670
	Point 2			Cat 12683
	Screw fixing (assorted pack)			D5894
Rack Mounting Kit				D5831

FIG. 46 GENERAL PARTS LIST D8300

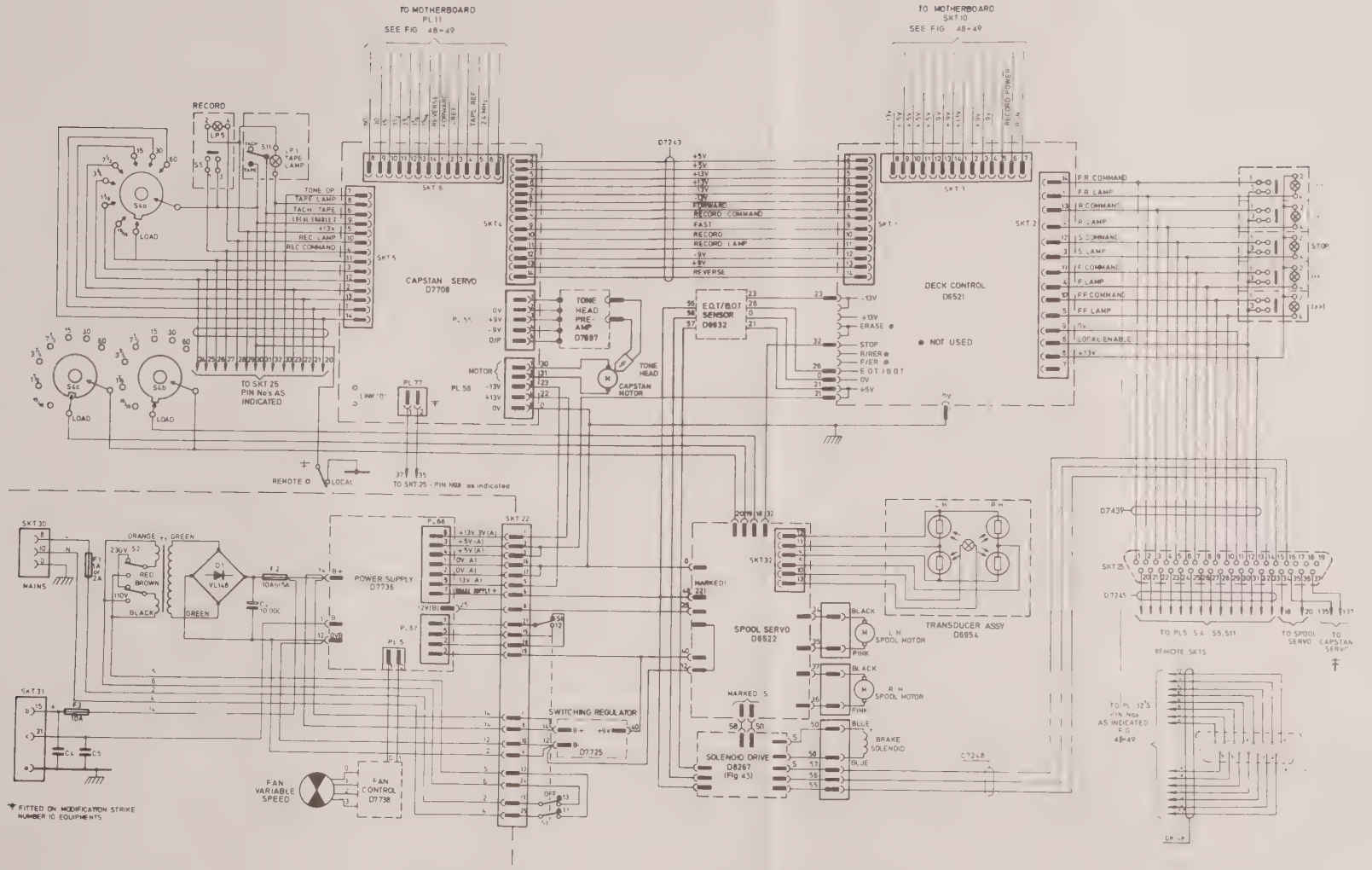


FIG. 47
TRANSPORT AND POWER
INTERCONNECTION DIAGRAM

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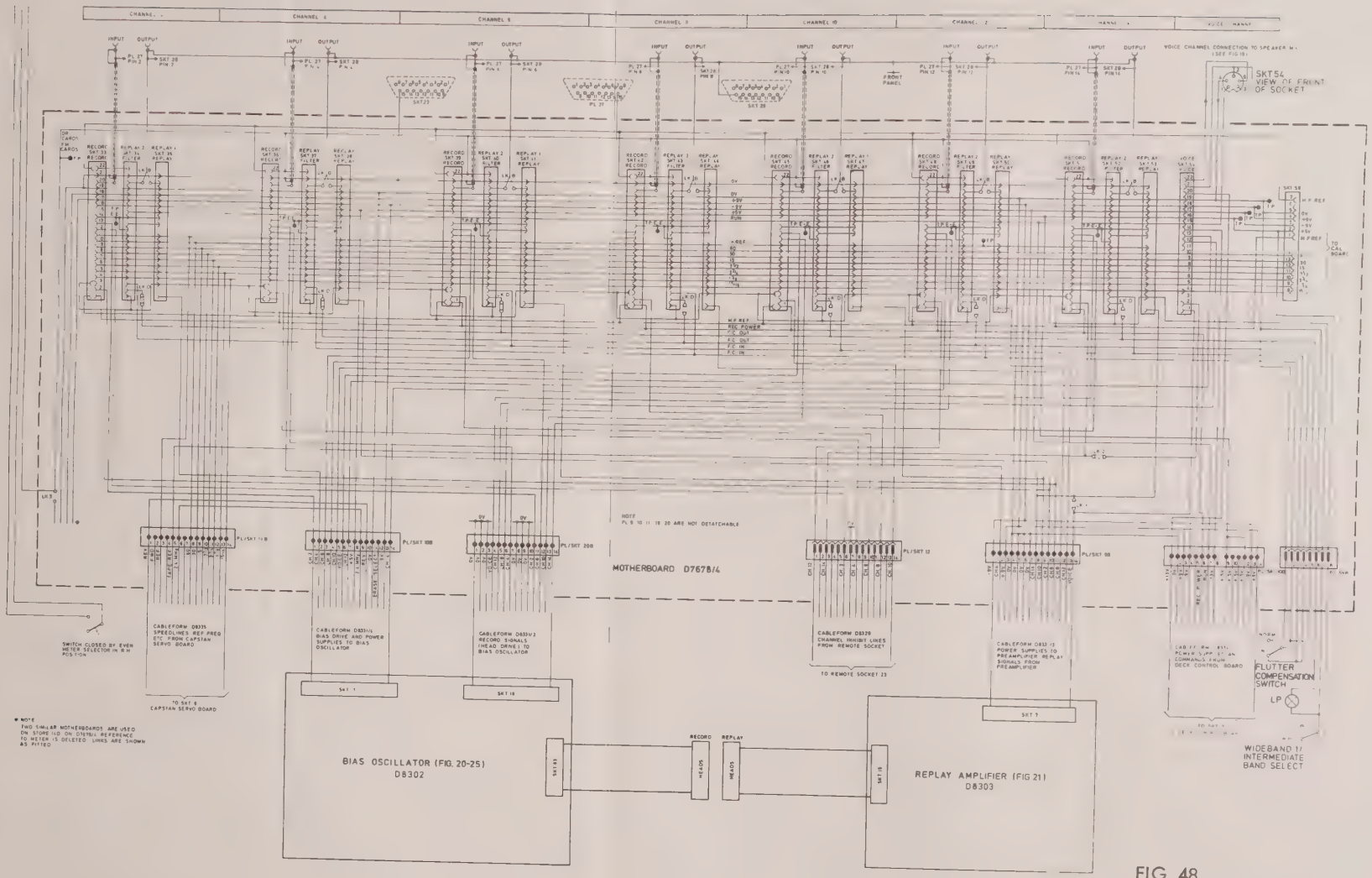

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FIG. 48
MOTHERBOARD/SIGNAL CIRCUITS
INTERCONNECTION DIAGRAM
(Even Channels)

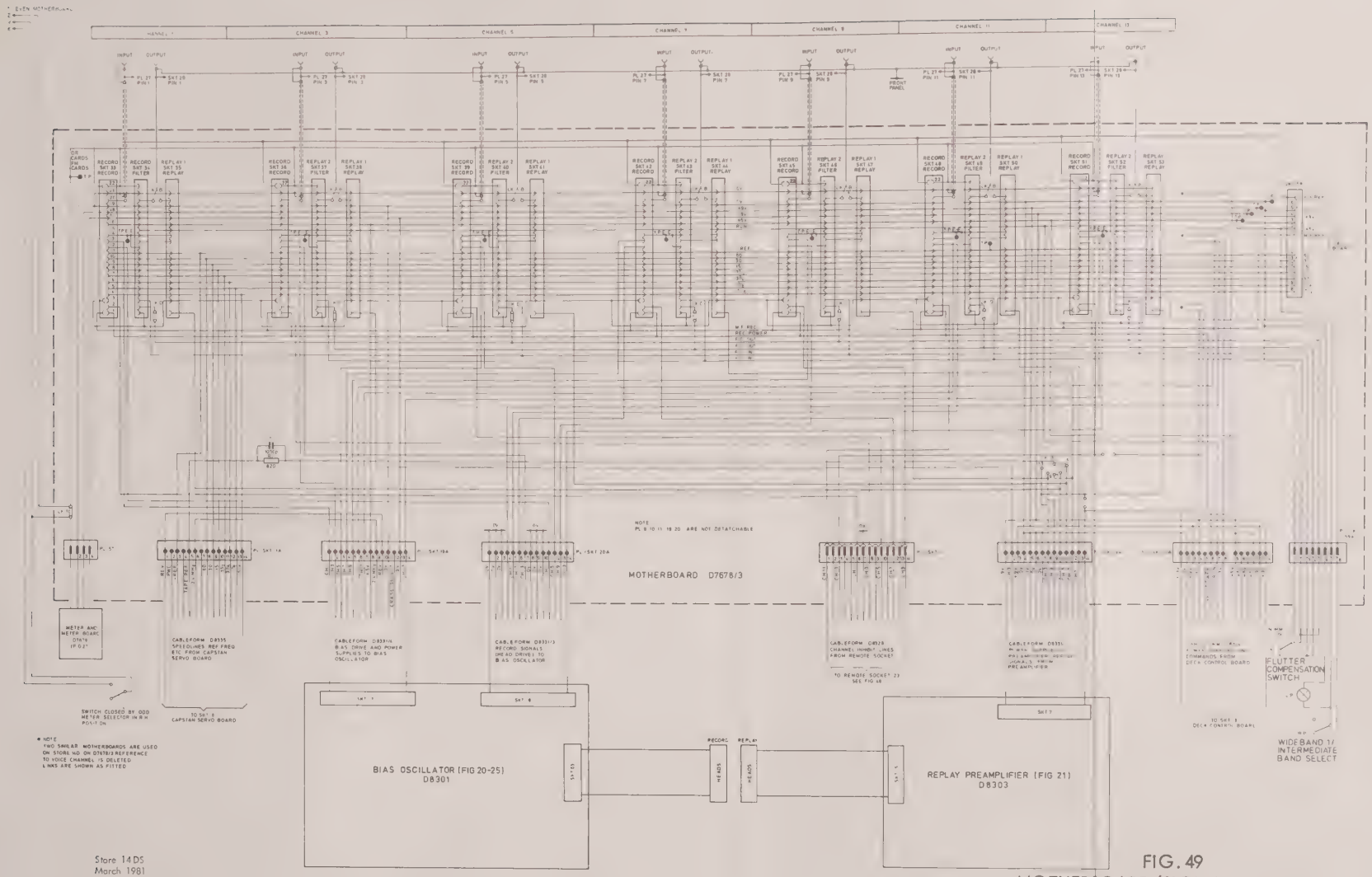
CHANNEL 1
CHANNEL 3
CHANNEL 5
CHANNEL 7
CHANNEL 9
CHANNEL 11
CHANNEL 13
INPUT
OUTPUT
RECORD SKT 38 RECORD
RECORD SKT 36 RECORD
RECORD SKT 39 RECORD
RECORD SKT 12 RECORD
RECORD SKT 45 RECORD
RECORD SKT 48 RECORD
RECORD SKT 51 RECORD
REPLAY 1 SKT 55 REPLAY
REPLAY 2 SKT 37 FILTER
REPLAY 1 SKT 38 REPLAY
REPLAY 2 SKT 40 FILTER
REPLAY 1 SKT 41 REPLAY
REPLAY 2 SKT 43 FILTER
REPLAY 1 SKT 44 REPLAY
REPLAY 2 SKT 46 FILTER
REPLAY 1 SKT 47 REPLAY
REPLAY 2 SKT 49 FILTER
REPLAY 1 SKT 50 REPLAY
REPLAY 2 SKT 52 FILTER
REPLAY SKT 53 REPLAY
FRONT PANEL
MOTHERBOARD D7678/3
NOTE PL 8 10 11 18 20 ARE NOT DETATCHABLE
METER AMP METER BOARD D7679 (FIG 3)
SWITCH CLOSED BY ODD METER SELECTOR IN B-H POSITION
CABLEFORM D8335 SPEEDLINES REF FREQ ETC FROM CAPSTAN SERVO BOARD
TO SKT 8 CAPSTAN SERVO BOARD
CABLEFORM D8331/4 BIAS DRIVE AND POWER SUPPLIES TO BIAS OSCILLATOR
CABLEFORM D8331/3 RECORD SIGNALS (HEAD DRIVES) TO BIAS OSCILLATOR
CABLEFORM D8328 CHANNEL INHIBIT LINES FROM REMOTE SOCKET
TO REMOTE SOCKET 23 SEE FIG 48
CABLEFORM D8331 PLAYBACK SIGNALS (HEAD) FROM PREAMPLIFIER
COMMANDS FROM DECK CONTROL BOARD
TO SKT 8 DECK CONTROL BOARD
FLUTTER COMPENSATION SWITCH
WIDEBAND 1/ INTERMEDIATE BAND SELECT
BIAS OSCILLATOR (FIG 20-25) D8301
REPLAY PREAMPLIFIER (FIG 21) D8303
RECORD
REPLAY
HEADS
SKT 3
SKT 5
SKT 7
SKT 8
* NOTE TWO SIMILAR MOTHERBOARDS ARE USED ON STORE 14D ON D7678/3 REFERENCE TO VOICE CHANNEL IS DELETED LINKS ARE SHOWN AS FITTED

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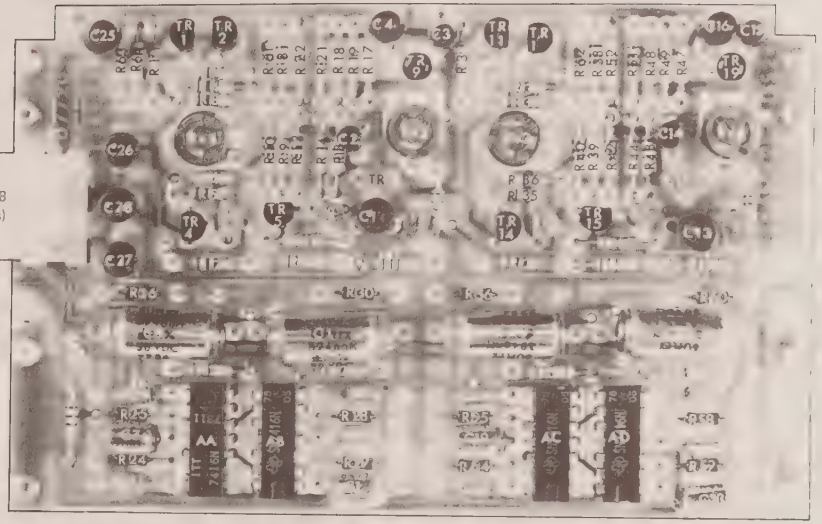
FIG. 49
MOTHERBOARD/SIGNAL CIRCUITS
INTERCONNECTION DIAGRAM
(Odd Channels)

CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	D.R.C ALIBRATION BOARD			D7720 '1 D7720 '2
Capacitors				
C1, 9, 13, 16, 27, 28	47 µF	20%	10V	Cat 13433
C2, 14	6.8 µF	20%	16V	Cat 14212
C3, 15, 25, 26	33 µF	20%	16V	C163330
C5	592 pF	2½%	30V	Cat 14213
C6, 10, 18, 22	1850 pF	2½%	30V	Cat 14214
C7, 11, 19, 23	9350 pF	2½%	30V	Cat 14216
C8, 12, 20, 24	39400 pF	2½%	30V	Cat 14219
C9	470 pF	2½%	30V	Cat 14632
C17, 21	560 pF	2½%	30V	Cat 14909
Integrated Circuit				
AA, AB, AC, AD	SN7416N			Cat 12098
Potentiometers				
RV1	470Ω	Cermet		Cat 11926
RV2, 4	220Ω	Cermet		Cat 13858
RV3	4k7	Cermet		Cat 12411
Resistors				
R1, 14, 31, 35	10k	5%	¼ W	R10103
R2, 19, 49	12k	5%	¼ W	R10123
R3, 4, 5, 7, 10, 12, 33, 34, 37, 40, 42, 51	1k	5%	¼ W	R10102
R6, 11, 36, 41	6k8	5%	¼ W	R10682
R9	560Ω	5%	¼ W	R10561
R15, 45	121Ω	1%	⅛ W	R201210
R16, 46	68R1	1%	⅛ W	R206819
R17, 47	39k	5%	¼ W	R10393
R18, 48	150k	5%	¼ W	R10154
R19, 49	12k1	1%	⅛ W	R201212
R20, 50	221Ω	1%	⅛ W	R202210
R21	68Ω	5%	¼ W	R10680
R22, 52, 61, 62	100Ω	5%	¼ W	R10101
R23, 27, 53, 57	15Ω	5%	¼ W	R10150
R24, 25, 26, 28, 29, 30, 54, 55, 56, 58, 59, 60	2M2	5%	¼ W	R10225
R38	68k	5%	¼ W	R10683
R39	5k6	5%	¼ W	R10562
R44	56k	5%	¼ W	R10563
R63, 64	10Ω	5%	¼ W	R10100

cableform to SKT 58 on Motherboard(s)



CIRCUIT REF.	VALUE	TOL	RATING	MFRS. REF. NO.
	D.R. CALIBRATION BOARD (Cont)			D7720 '1 D7720 '2
Transistors				
TR1, 2, 4, 5, 11, 12, 14, 15	BC2378			Cat 11976
TR3, 6, 7, 8, 13, 16, 17, 18	BC3088			Cat 11977
TR9, 19	E112 F.E.T.			Cat 10540

D7720/1 STORE 4DS, STORE 7DS, STORE 4DN
D7720/2 STORE 14DS

FIG. 50 D.R. CALIBRATION BOARD - LAYOUT D7720

Store 14DS
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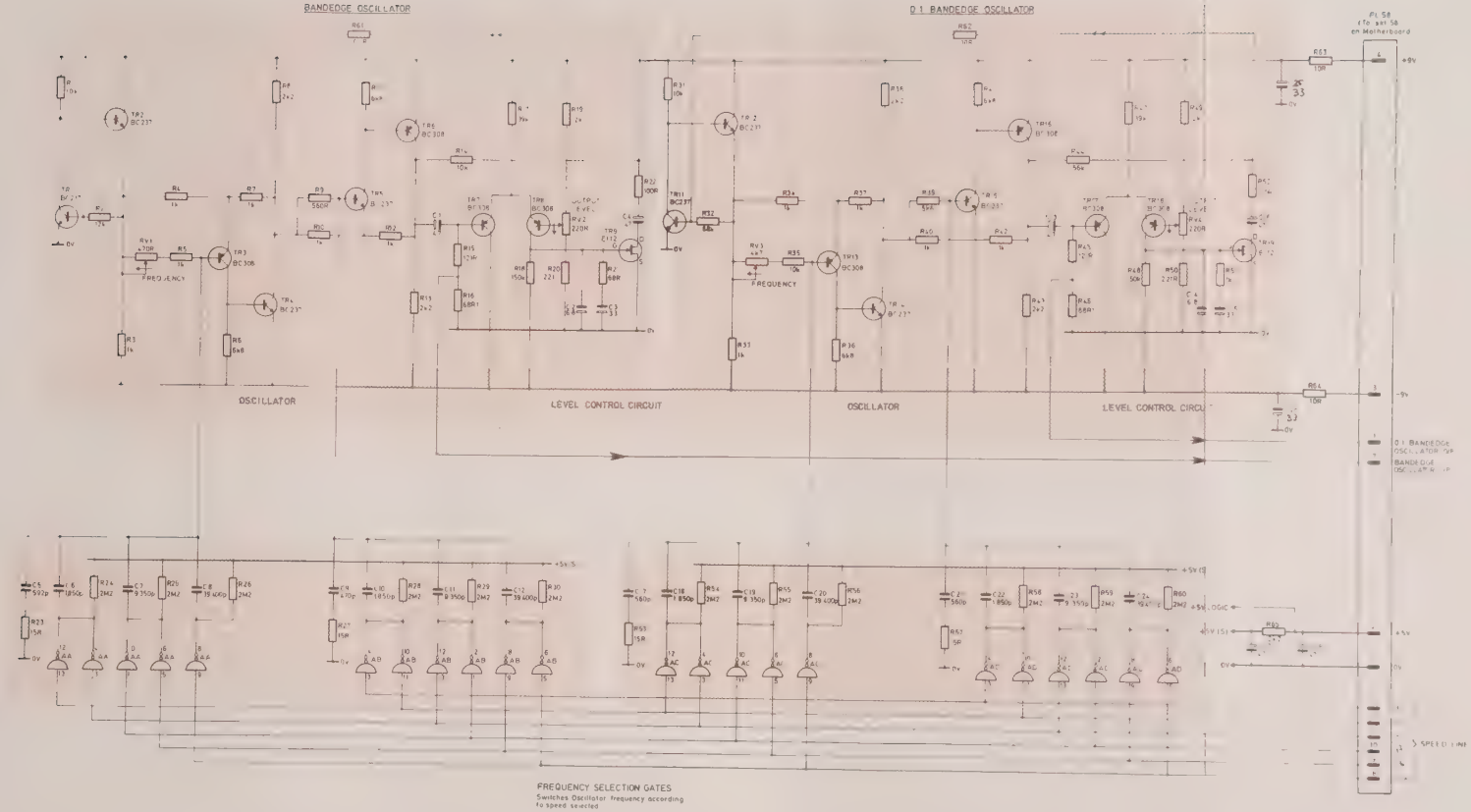

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FIG.51
D.R. CALIBRATION BOARD - CIRCUIT

APPENDIX A

"STORE" RANGE FILTER TYPES (Dual Standard)

1. The "Store" range Instrumentation Recorders incorporate active low pass filters in the replay circuits. Above the cut-off frequency the amplitude response falls at a rate approaching 24 dB/octave, ensuring that very little of the f.m. carrier is present in the output signal. A switch on each filter board selects either Tchebychef or Bessel response. The Tchebychef provides greater carrier attenuation while Bessel provides linear phase response.

2. The optimum filter type will depend on the application for which the recorder is intended; with this in mind the following factors should be considered:-

(a) Carrier Attenuation. The amount of carrier attenuation limits the signal-to-noise ratio; for example, if after filtering there remains a -50 dBm residual carrier signal, then the best signal-to-noise ratio that can be achieved is 50 dB. Worst case conditions for "Store" range recorders are when a peak negative signal occurs. In this situation the carrier frequency is 40% less than the centre carrier frequency and consequently is attenuated less by the filter.

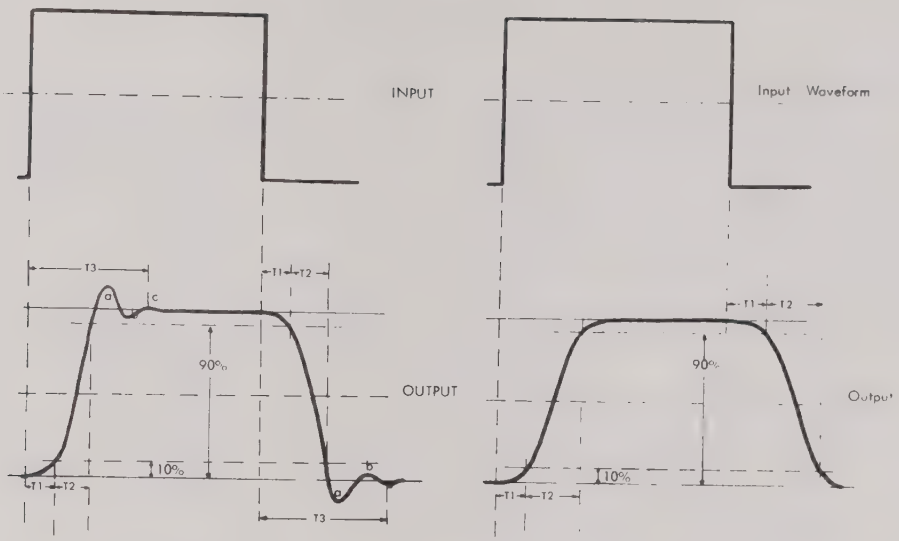
(b) Amplitude/Frequency Response. Ideally the response of the filter within the passband should be perfectly flat. The degree of departure from the ideal is tabulated below for the two filter types.

(c) Phase Response. A filter with a non-linear phase/frequency response will introduce some overshoot on fast rise-time signal waveforms. Although in neither of the filters considered are these effects severe, there are occasions when any overshoot is undesirable. In these cases a constant delay (linear phase) filter should be used (see para 3 below).

3. The tables below give an indication of the performance of the two types of filter. It can be seen that the Tchebychef filter gives a flatter passband response and greater carrier attenuation. The Bessel filter provides a linear phase response.

		Tchebychef	Bessel
Passband * Response		Slight Ripple Less than ± 0.5 dB at band edge	-3 dB at band edge
Residual Carrier at -40%		-53 dB	-38 dB
Overshoot (see below)	a	+15%	-
	b	-5%	-
	c	+3%	-

* Tables of Tchebychef and Bessel frequency response are contained in Chapter 3.



TCHEBYCHEF

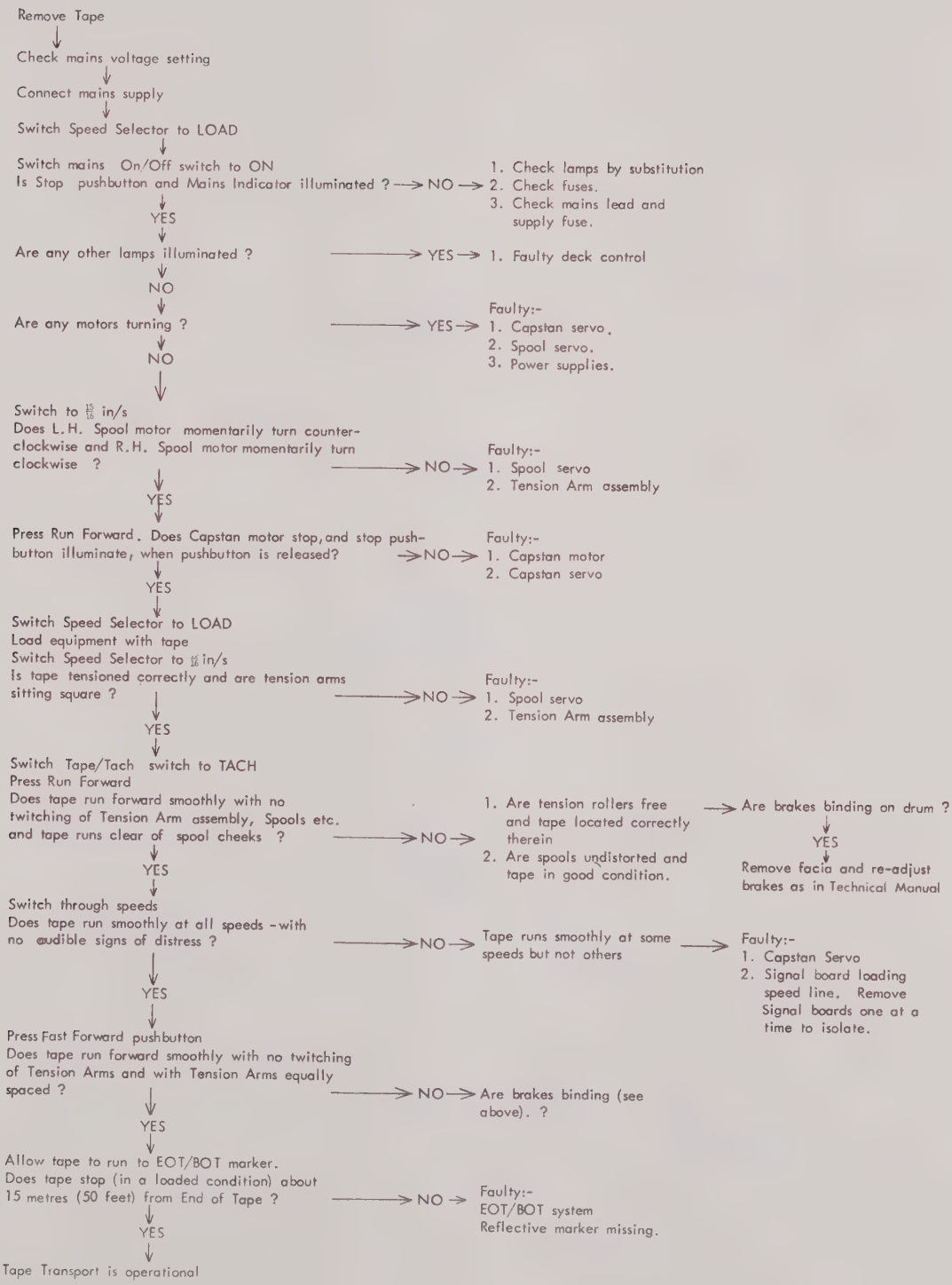
BESSEL

SPEED IN/S		TCHEBYCHEF			BESSEL	
Inter. Band	Wide Band 1	T1	T2	T3	T1	T2
$\frac{15}{16}$	–	800 µs	1040 µs	5040 µs	640 µs	1250 µs
$1\frac{7}{8}$	$\frac{15}{16}$	400 µs	520 µs	2520 µs	320 µs	640 µs
$3\frac{3}{4}$	$1\frac{7}{8}$	200 µs	260 µs	1260 µs	160 µs	320 µs
$7\frac{1}{2}$	$3\frac{3}{4}$	105 µs	130 µs	635 µs	85 µs	160 µs
15	$7\frac{1}{2}$	53 µs	65 µs	317 µs	45 µs	80 µs
30	15	30 µs	32 µs	162 µs	25 µs	40 µs
60	30	17 µs	17 µs	84 µs	15 µs	20 µs
–	60	11 µs	9 µs	47 µs	10 µs	12 µs

Comparison of Delay Time (T1), Rise Time (T2) and Settling Time (T3) for Tchebychef and Bessel filters when measured on Store 4DS/Store 7DS Instrumentation Recorder.

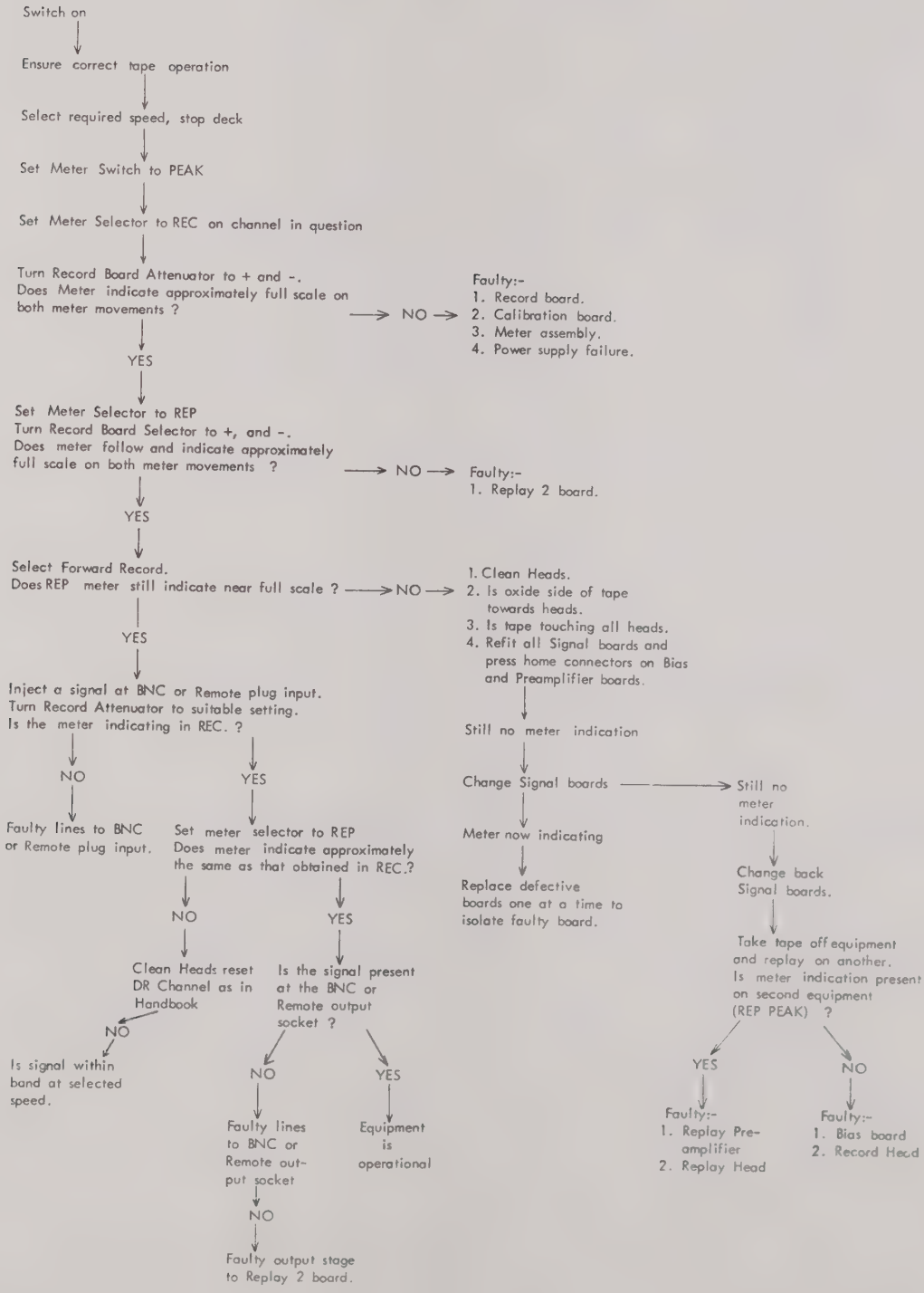
APPENDIX B

DIAGNOSTIC AID - TAPE TRANSPORT

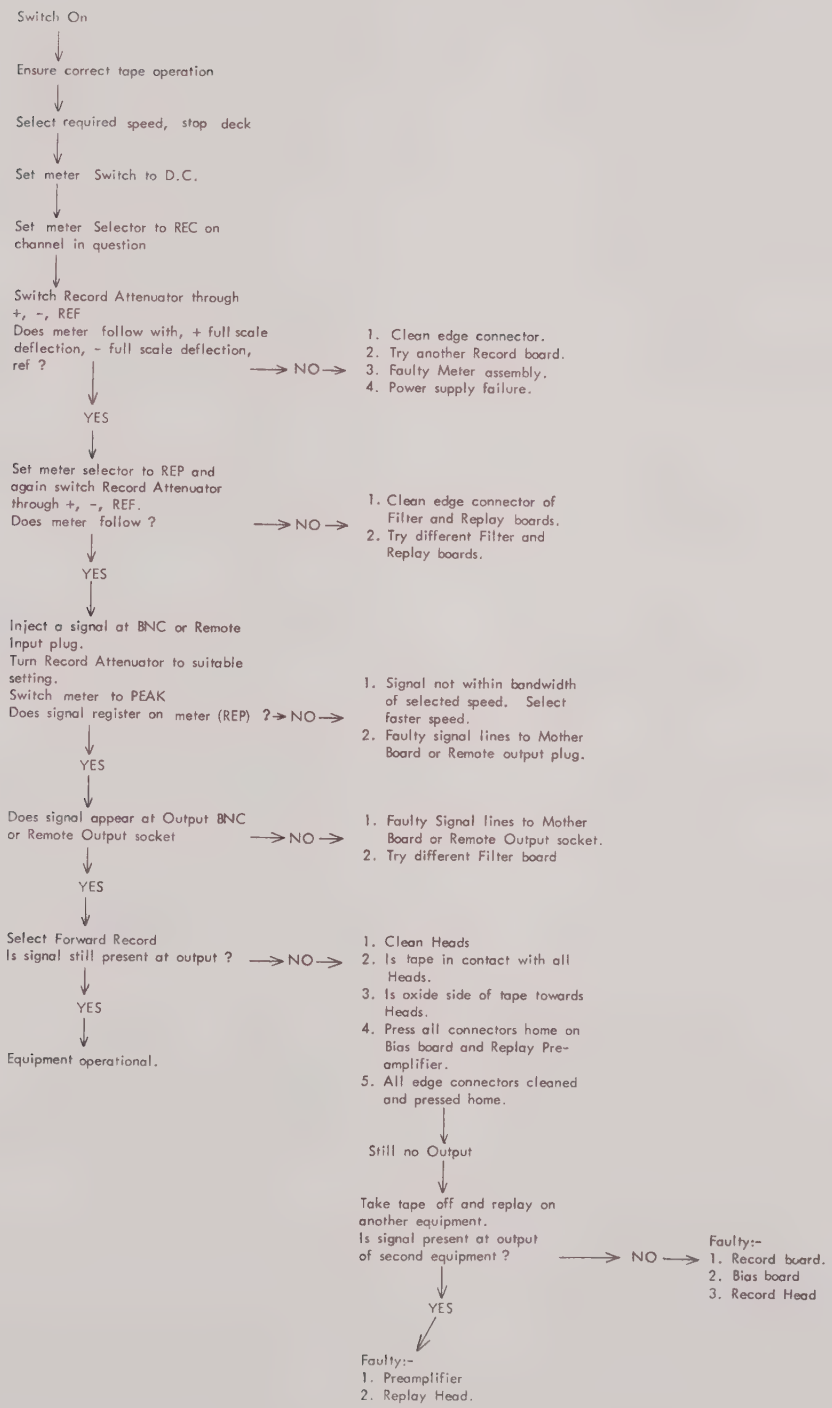

Remove Tape
Check mains voltage setting
Connect mains supply
Switch Speed Selector to LOAD
Switch mains On/Off switch to ON
Is Stop pushbutton and Mains Indicator illuminated ?
NO
1. Check lamps by substitution
2. Check fuses.
3. Check mains lead and supply fuse.
YES
Are any other lamps illuminated ?
YES
1. Faulty deck control
NO
Are any motors turning ?
YES
Faulty:-
1. Capstan servo.
2. Spool servo.
3. Power supplies.
NO
Switch to 15/16 in/s
Does L.H. Spool motor momentarily turn counter-clockwise and R.H. Spool motor momentarily turn clockwise ?
NO
Faulty:-
1. Spool servo
2. Tension Arm assembly
YES
Press Run Forward. Does Capstan motor stop, and stop push-button illuminate, when pushbutton is released?
NO
Faulty:-
1. Capstan motor
2. Capstan servo
YES
Switch Speed Selector to LOAD
Load equipment with tape
Switch Speed Selector to 15/16 in/s
Is tape tensioned correctly and are tension arms sitting square ?
NO
Faulty:-
1. Spool servo
2. Tension Arm assembly
YES
Switch Tape/Tach switch to TACH
Press Run Forward
Does tape run forward smoothly with no twitching of Tension Arm assembly, Spools etc. and tape runs clear of spool cheeks ?
NO
1. Are tension rollers free and tape located correctly therein
2. Are spools undistorted and tape in good condition.
Are brakes binding on drum ?
YES
Remove facia and re-adjust brakes as in Technical Manual
YES
Switch through speeds
Does tape run smoothly at all speeds - with no audible signs of distress ?
NO
Tape runs smoothly at some speeds but not others
Faulty:-
1. Capstan Servo
2. Signal board loading speed line. Remove Signal boards one at a time to isolate.
YES
Press Fast Forward pushbutton
Does tape run forward smoothly with no twitching of Tension Arms and with Tension Arms equally spaced ?
NO
Are brakes binding (see above). ?
YES
Allow tape to run to EOT/BOT marker.
Does tape stop (in a loaded condition) about 15 metres (50 feet) from End of Tape ?
NO
Faulty:-
EOT/BOT system
Reflective marker missing.
YES
Tape Transport is operational

DIAGNOSTIC AID - D.R. SIGNAL CIRCUITS

(Using D.R. Calibration Board)


Switch on
Ensure correct tape operation
Select required speed, stop deck
Set Meter Switch to PEAK
Set Meter Selector to REC on channel in question
Turn Record Board Attenuator to + and -.
Does Meter indicate approximately full scale on both meter movements ?
NO
Faulty:-
1. Record board.
2. Calibration board.
3. Meter assembly.
4. Power supply failure.
YES
Set Meter Selector to REP
Turn Record Board Selector to +, and -.
Does meter follow and indicate approximately full scale on both meter movements ?
NO
Faulty:-
1. Replay 2 board.
YES
Select Forward Record.
Does REP meter still indicate near full scale ?
NO
1. Clean Heads.
2. Is oxide side of tape towards heads.
3. Is tape touching all heads.
4. Refit all Signal boards and press home connectors on Bias and Preamplifier boards.
YES
Inject a signal at BNC or Remote plug input.
Turn Record Attenuator to suitable setting.
Is the meter indicating in REC. ?
NO
YES
Still no meter indication
Change Signal boards
Still no meter indication.
Meter now indicating
Replace defective boards one at a time to isolate faulty board.
Change back Signal boards.
Faulty lines to BNC or Remote plug input.
Set meter selector to REP
Does meter indicate approximately the same as that obtained in REC.?
NO
YES
Take tape off equipment and replay on another.
Is meter indication present on second equipment (REP PEAK) ?
YES
NO
Faulty:-
1. Replay Pre-amplifier
2. Replay Head
Faulty:-
1. Bias board
2. Record Head
Clean Heads reset DR Channel as in Handbook
Is the signal present at the BNC or Remote output socket ?
NO
Is signal within band at selected speed.
NO
YES
Faulty lines to BNC or Remote output socket
Equipment is operational
NO
Faulty output stage to Replay 2 board.

DIAGNOSTIC AID - F.M. SIGNAL CIRCUITS


Switch On
Ensure correct tape operation
Select required speed, stop deck
Set meter Switch to D.C.
Set meter Selector to REC on channel in question
Switch Record Attenuator through +, -, REF
Does meter follow with, + full scale deflection, - full scale deflection, ref ?
NO
1. Clean edge connector.
2. Try another Record board.
3. Faulty Meter assembly.
4. Power supply failure.
YES
Set meter selector to REP and again switch Record Attenuator through +, -, REF.
Does meter follow ?
NO
1. Clean edge connector of Filter and Replay boards.
2. Try different Filter and Replay boards.
YES
Inject a signal at BNC or Remote Input plug.
Turn Record Attenuator to suitable setting.
Switch meter to PEAK
Does signal register on meter (REP) ?
NO
1. Signal not within bandwidth of selected speed. Select faster speed.
2. Faulty signal lines to Mother Board or Remote output plug.
YES
Does signal appear at Output BNC or Remote Output socket
NO
1. Faulty Signal lines to Mother Board or Remote Output socket.
2. Try different Filter board
YES
Select Forward Record
Is signal still present at output ?
NO
1. Clean Heads
2. Is tape in contact with all Heads.
3. Is oxide side of tape towards Heads.
4. Press all connectors home on Bias board and Replay Pre-amplifier.
5. All edge connectors cleaned and pressed home.
YES
Equipment operational.
Still no Output
Take tape off and replay on another equipment.
Is signal present at output of second equipment ?
NO
Faulty:-
1. Record board.
2. Bias board
3. Record Head
YES
Faulty:-
1. Preamplifier
2. Replay Head.

APPENDIX B

SUPPLEMENT TO STORERANGE TECHNICAL MANUALS

REMOTE CONTROL UNIT RC4714

GENERAL DESCRIPTION

1. The Remote Control Unit RC4714 is a unit especially designed for the remote control of all Store Range equipments.

2. The unit is housed in a robust case. It has pushbuttons, indicators, and a display showing 'tape footage'. The remote control unit derives its power from the Store Range Equipment to which it is connected.

3. Connection to a Store Range Equipment is via a 37 way plug and flatstrip cable. It plugs into the remote socket of the Recorder.

INSTALLATION AND OPERATION

4. Follow the installation instructions for the Store Range Equipment. These are contained in Chapter 2 of its Technical Manual.

5. To instal the Remote Control Unit RC4714 it is necessary only to connect its 37 way plug to the socket at the rear of the Store Range Recorder.

6. If the screwlocks are to be used (to secure plug to socket) they should be tightened 'two turns at a time'. This will ensure even mating. Similarly at disconnection they must be unscrewed 'two turns at a time'.

7. If the Remote Control Unit is to be used with older Store Range Equipment, not fitted for screwlocks, the screws may need to be removed altogether to ensure that the plug and remote socket mate properly.

Tape Movement Controls.

8. Pushbuttons on the Remote Control Unit allow selection of:-

'<<' fast reverse.
'<' reverse
'stop'
'>' forward
'>>' fast forward

The pushbuttons may be used in any order without fear of damage to tape.

9. Light Emitting Diodes (LEDs), associated with the pushbuttons, indicate which mode is in operation.

10. When the control unit is connected both remote and local tape movement controls are in operation and will give the same indication.

Tape Speed Controls.

11. The selected speed is shown by the illumination of one of seven LEDs and will indicate a speed in the range $\frac{15}{16}$ to 60 in/s.

12. Tape speed is normally selected by the speed switch on the Store Range Recorder. Control of tape speed can be assumed by the Remote Control Unit as follows:-

(a) On the 'DS' range of equipments the local enable switch, (at the L.H. side under the front flap) must be set away from local.

(b) On other Store Range equipments link G, on the Deck Control Board, must be removed, as described in Chapter 2 of the relevant Technical Manual.

13. On completion of para 12 (a) or (b) above, speed selection can take place only at the Remote Control Unit. Pressing the 'speed' button will cause recorder speed to step through the range $\frac{15}{16}$ to 60 in/s, one step at a time. Select the required speed before operating tape movement controls.

14. A further step in the tape speed sequence between 60 and $\frac{15}{16}$ in/s illuminates the 'local' indicator on the Remote Control Unit. In this condition selection of tape speed is returned to the Store Range recorder. It will operate normally in the 'local' condition as long as the Remote Control Unit remains connected. If it is required to operate the Store Range Recorder without the Remote Control Unit, Link 'G' must be replaced, on the

Deck Control Board, or, on DS range of equipment the local enable switch set back to 'local'.

Tape Footage Counter.

15. This counter displays the length of tape 'played'. A reset button is provided and it is recommended that the display is zeroed at the beginning of tape.

SPECIFICATION

16. The policy of Racal Recorders Ltd. is one of continuous development and consequently the equipment may vary in detail from the description and specification in this publication.

17. The Remote Control Unit RC4714 is for use with the following Store Range Equipments:-

Store 4/7/14
Store 4D/7D/14D
Store 4DS/7DS/14DS
Store 4EN
Storefax

18. The Remote Control Unit is supplied with a 5 metre length of cable. It can, however, be operated at distances of up to 30 metres.

General Items.

19.

Size	100 mm x 120 mm x 50 mm
Connector	37 way 'D' type
Power Supply	from Store Range Recorder
Racal Part No.	Cat 14197

MP MASTER
MA31075